No. 8

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ANN ARBOR, MICHIGAN 1951

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UNIVERSITY MICROFILMS, INC.
ANN ARBOR, MICHIGAN: 1959

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AGRICULTURE, GENERAL

THE FATE OF AMMONIA APPLIED TO SOILS.

(L. C. Card No. Mic 59-5307)

John Howard Baker, Ph.D.
Cornell University, 1959

The objectives of this investigation were to determine losses of ammonia upon application of anhydrous ammonia to soils, to study the factors influencing the ammonia retention capacity of soils, and to measure losses of ammonia from soils by leaching.

A method was developed for measuring directly application losses of ammonia under field conditions. Losses of ammonia were found to be negligible from soils at optimum moisture content when anhydrous ammonia was applied at all practical rates even to a depth of only four inches below the surface. The distribution of ammonia within the band was determined after spraying a gypsum suspension, containing phenol red, on the cross section of the ammonia band. In loose soils, the cross section of the band was found to be circular, but in compacted soils, the ammonia band did not approach circular symmetry owing to diffusion of ammonia through the crevice made by the applicator blade.

The ammonia retention capacity of several representative New York surface soils and subsoils was determined by saturating the soils with ammonia followed by aeration for one week to permit the escape of physically sorbed ammonia. The amount of ammonia retained was then calculated as the difference between the total nitrogen content of the ammoniated soil and that of the corresponding untreated soil. About one-fourth of the ammonia retained by many soils was found to be fixed in a form not extractable with a 10 percent NaCl solution. The largest amounts of ammonia were retained and fixed by acid soils containing large amounts of organic matter.

Calculations of the surface potential and the pH on the surface of the clay particle showed that the amount of exchangeable hydrogen neutralized upon ammoniation (the ammonia retention capacity) should be lower than the exchangeable hydrogen content of the soil as determined by either the residual carbonate or the ammonium acetate method. The ammonia retention capacity of most soils was found to be lower than the exchangeable hydrogen content as determined by the residual carbonate method but exceeded that calculated by subtracting the sum of the exchangeable metal cations from the exchange capacity as determined by the ammonium acetate method. The exchange capacity of many soils obtained by the conventional ammonium acetate method was shown to be in error inasmuch as the results were found to be 4 to 5 me. per 100 grams higher when the excess of ammonium acetate was removed with 99 percent isopropyl alcohol instead of 95 percent ethyl alcohol. This discrepancy may be attributed to loss of some adsorbed ammonium ions in removing the excess of ammonium acetate with ethyl alcohol. It may be concluded, therefore, that the ammonia retention capacity of a soil is determined primarily by the amount of exchangeable hydronium and aluminum ions and that the results for exchange capacity of many soils as determined by the conventional ammonium acetate method are low.

In a study of the losses of the NH_4^+ ion by leaching, ammonia-nitrogen was applied to an acid (pH 5.1) and a neutral (pH 7.2) Mardin silt loam at the rate of 500 pounds of N per acre as anhydrous ammonia, NH_4NO_3, $(NH_4)_2SO_4$, and $NH_4H_2PO_4$. An amount of water equivalent to 2.6 inches of rain was then applied to the soil, and the amount of ammonia-nitrogen lost by leaching was determined by analysis of the percolates. Less than 3 percent of the ammonia-nitrogen applied as anhydrous ammonia and $NH_4H_2PO_4$ was lost from both soils. An equally small amount was lost from the neutral soil treated with NH_4NO_3 and $(NH_4)_2SO_4$. On the other hand as much as 25 percent of the ammonia-nitrogen applied as these two salts was lost by leaching from the acid soil because of the difficulty with which monovalent cations replace the adsorbed aluminum ions. The greater retention of ammonia-nitrogen applied as anhydrous ammonia may be attributed to the reaction of ammonia with the exchangeable aluminum and hydronium ions. The retention of the NH_4^+ ion, applied as $NH_4H_2PO_4$, may be attributed to the formation of sparingly soluble calcium, magnesium, and aluminum phosphates as a result of the exchange adsorption of the ammonium ion.

Microfilm $2.00; Xerox $4.40. 81 pages.

A STUDY OF SELECTED FACTORS INVOLVED WITH EARLY POST-MORTEM TENDERNESS OF POULTRY MEAT.

(L. C. Card No. Mic 59-4135)

John Wesley Dodge, Ph.D.
Purdue University, 1959

Major Professor: W. J. Stadelman

The work was designed to investigate several factors believed to be associated with post-mortem tenderization. These factors were: struggling prior to and during slaughter, pH, per cent of total water in the tissue, per cent of free water in the tissue, water uptake and loss during aging, methods of aging meat, and effects of tranquilization on struggling and tenderness. An attempt was also made to investigate evaluation of tenderness on raw meat. The investigations were made on both chickens and turkeys of various ages and breeds. A total of 288 chickens and 168 turkeys were used in these studies.

Struggling and tranquilization were found to exert no effect on tenderness as measured, but in two cases

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

tranquilization was found to influence the relationship between struggling and tenderness.

A very close relationship was found between pH and tenderization in turkey meat which suggests that tenderness evaluations could be made by pH measurements in early post-mortem periods. The investigation of tenderness measurement by shearing of raw meat resulted in statistically significant relationships between raw shear scores and panel evaluations, but even stronger relationships were observed between cooked shear scores and panel evaluations.

Moisture levels in the meat were found by statistical methods to exert little influence on tenderness. Dehydration during aging was found to be a significant factor in causing lack of tenderness during aging in air, whereas moisture uptake during aging in water appeared to produce no tenderizing effect. When carcasses aged in air were covered with polyethylene the meat was found to be no less tender than that of carcasses aged in slush ice at the same temperature. The dehydration effect was found to be most serious immediately after feather removal possibly because of the higher body temperature and rapid loss of water. Microfilm $2.00; Xerox $5.80. 117 pages.

CHARACTERIZATION OF PED SURFACES IN CONTRAST TO PED INTERIORS FROM B HORIZONS OF SOME MAJOR GREAT SOIL GROUPS IN ILLINOIS.

(L. C. Card No. Mic 59-4514)

Robert Bruce Grossman, Ph.D.
University of Illinois, 1959

Ped surfaces apparently are sites for both extensive parent material alteration and plant root to soil contact. The principal objective of this study was to compare the surfaces and the interiors of peds from the B horizons of selected soils in Illinois. The study had two principal phases: the morphological description of the ped surfaces and the ped interiors; and a comparison of a sample from the ped surface to the bulked peds in respect to particle-size distribution, clay mineralogy, and iron content of the clay. A third phase was bulk density determinations on discrete peds.

The genetic relationships and the series studied were as follows: a Brunizem to Planosol sequence developed in Peorian loess under grass vegetation–Muscatine, Herrick, Cowden, and Cisne; a Gray-Brown Podzolic sequence developed in Peorian loess under forest vegetation–Seaton, Fayette, and Clinton; a vegetation sequence from Brunizem to Gray-Brown Podzolic in nominally Wisconsin-age till with an admixture of loess–Elliott, Beecher, and Blount; and another Elliott profile developed in Wisconsin-age till with little loess influence.

Commonly, the ped surfaces are a complex of blanched, silt-rich (degradational) and clay-rich (accretive) areas. The silicate clay is in preferred orientation in the accretive areas, paralleling the ped surface. Immediately to the inside of the ped surface, a clay-poor and commonly blanched zone usually occurs, in which the clay shows preferred orientation parallel with the ped surface. Degradation is more strongly expressed on the ped surfaces than on the walls of the large noncapillary voids of the ped interior.

Water movement across the ped surface and gravitational water movement parallel to the ped surface should be greater than in the ped interior. This special water regime may largely determine the ped surface morphology.

A sample of the ped surface was obtained by washing 1/4- to 3/8-inch, kerosene-saturated peds with Calgon. Roughly the same weight of material (ca. 0.5 percent) was removed per unit weight of peds. For a narrow ped class, this approximates equal weight per unit of ped surface area. Comparisons were made to the bulked 1/4- to 3/8-inch peds.

Particle-size analyses made with the density gradient tube show that the ped surface silt is slightly coarser than that from the bulked peds and that the clay has a relatively bimodal particle-size distribution, with more of the $<0.04\mu$ and $>0.5\mu$ fractions. Intensity of the weathering regime (perhaps related to the moisture regime as discussed above) may be responsible for the coarser silt. The bimodal clay particle-size distribution probably reflects contributions of fine clay from the accretive areas and of coarse clay from the degradational areas.

For horizons that also contain considerable nonexpanding 2:1-lattice clays, degradational ped surfaces are lower in montmorillonite than the bulked peds and accretive surfaces are higher. Ped surface clays are more resistant to collapse on heating to 450° C.; this may be due to aluminum accumulation between the lattice layers.

As based on relative FeK intensity, the clays from the ped surface contain less total iron. The difference may be due to removal of "free iron" by organic chelators and reducing compounds, aided by the large amount of water movement.

The mean bulk density discrete peds from all horizons is 1.75 g. per cc., and the range is from 1.63 to 1.80 g. per cc. These bulk densities may be sufficiently high to restrict root penetration.

Microfilm $2.55; Xerox $8.80. 193 pages.

THE ASSAY OF SUCCINIC DEHYDROGENASE OF PERIPLANETA AMERICANA AND ITS REACTION WITH THE INSECTICIDE, ROTENONE.

(L. C. Card No. Mic 59-3590)

Raymond Franklin Moore, Jr., Ph.D.
Rutgers University, 1959

Major Professor: Dr. Andrew J. Forgash

The succinic dehydrogenase activity in tissues from Periplaneta americana was studied in muscle homogenates and acetone powder preparations by spectrophotometric methods involving ferricyanide and neotetrazolium as electron acceptors and also by a manometric method in which phenazine methosulfate was used as an acceptor.

A procedure for isolating an acetone powder, which has greater succinic dehydrogenase activity than comparable concentrations of muscle tissue as determined by the phenazine methosulfate assay, is described.

The effects of rotenone as an inhibitor were studied

both in vivo and in vitro for the amount and type of inhibition, and were analyzed with the aid of Lineweaver-Burk formulations of the data.

The possibility that the -SH groups of succinic dehydrogenase served as a reaction site with rotenone was investigated.

The phenazine methosulfate assay is the preferred method for assay of insect succinic dehydrogenase because it is free from side reactions with intermediates of the respiratory chain which can occur with neotetrazolium or ferricyanide procedures. It does not require the addition of albumin in order to protect the enzyme as is the case when ferricyanide is used. Phenazine methosulfate is not auto-oxidizable in alkaline solutions compared to neotetrazolium. Intermediates are required for reaction of succinic dehydrogenase from insect muscle with the neotetrazolium or ferricyanide assays as shown by the absence of any reaction with an acetone powder, while the phenazine methosulfate assay shows a four fold increase in activity.

The failure of other investigators to detect inhibition by rotenone in vitro is explained by two factors: their failure to incubate homogenates with rotenone for a sufficiently long period of time and failure to place the rotenone in a sufficiently dispersed form to provide adequate contact with the enzyme.

The action of rotenone, both in vivo and in vitro, is explained as the result of two reactions. An initial reaction increases the affinity of the enzyme for the substrate but this increased activity of the enzyme induces changes which deactivate or denature it. When the inhibitory effects are dominant, a non-competitive type of inhibition is found.

The insect enzyme is more sensitive to PCMB inhibition than the beef heart enzyme and the inhibition is not as readily released by treatment with KCN. The results of the study of the reaction of rotenone, succinic dehydrogenase, and PCMB are equivocal.

Microfilm $2.00; Xerox $6.20. 128 pages.

STUDIES ON THE APPLICATION OF SOLUBLE FERTILIZERS THROUGH AN IRRIGATION SYSTEM: I. THE EFFECT OF VARIOUS NUTRIENT SOURCES AND METHODS OF FERTILIZER APPLICATION ON SELECTED VEGETABLE CROPS. II. THE MOVEMENT OF SOLUBLE SALTS IN POROUS MEDIA.

(L. C. Card No. Mic 59-5301)

Robert Henry Ruf, Jr., Ph.D.
Cornell University, 1959

I. The effect of various nutrient sources and methods of fertilizer application on selected vegetable crops.

A screening plot was established in 1957 to compare the relative response of nine vegetable crops to twelve different sources and methods of application of fertilizer. In 1958 the number of treatments was reduced to eight and crops to four (tomatoes, potatoes, cabbage, and snap-beans). Fertilizers were banded in granular and liquid forms, and applied through sprinklers in various forms and at different dates.

The use of liquid 8-8-8 placed in bands at planting consistently gave higher, but not statistically significant higher yields each year, than the granulated 12-12-12 applied in the same manner. The use of a split application for the nitrogen or the complete fertilizer did not alter the yield when compared to those treatments in which the fertilizers were applied all at planting. The use of fertilizer containing free ammonia applied through the sprinkler irrigation system caused severe foliar injury and subsequent decrease in yield.

II. The movement of soluble salts in porous media.

The movement of sodium nitrate in columns of soil, artificial soils and sands was studied. Segmented lucite columns of these porous media containing percolated sodium nitrate were either sectioned and analyzed for nitrate in the soil or the effluent was collected in successive aliquots in a fraction collector and then analyzed for nitrate.

The reproducibility of data as measured by three replications on several sand and soil columns was highly satisfactory as evaluated both graphically and statistically. The actual nitrate distribution in the soil at a given depth closely approximated the theoretical distribution

$$c/c_o = x_o\,(2\pi\beta\bar{x})^{-\frac{1}{2}} \exp\left[-(x-\bar{x})^2/2\beta\bar{x}\right]*$$

It was not found in these tests, however, that a particular value assigned to β would describe the nitrate distribution pattern at all depths.

* c = concentration of salt solution at time t and depth x
c_o = initial concentration of tracer substance
x_o = vertical thickness of a thin layer of salt solution = volume of liquid/E x area of surface
β = parameter of dispersion
$\bar{x}$ = vt
x = depth below surface of porous medium
E = volume of liquid/total volume of porous system
v = average velocity of liquid = macroscopic velocity/E
t = time in minutes

Microfilm $2.00; Xerox $4.20. 76 pages.

PRODUCER BENEFITS FROM THE OPERATIONS OF THE ONTARIO SUGAR BEET GROWERS' MARKETING BOARD.

(L. C. Card No. Mic 59-4562)

Ronald Stuart Rust, Ph.D.
University of Illinois, 1959

The major problem of this study was to discover whether the presence and operation of the Ontario Sugar Beet Growers' Marketing Board has financially benefited the Ontario sugar beet producers. This marketing board was organized in 1942. In the analyses of data, the periods 1930 to 1957, 1930 to 1941, and 1942 to 1957 were used. The last two were referred to as Period 1 and Period 2 respectively.

Multiple correlation was used to indicate whether the marketing board factor explained a significant part of the variance in sugar beet prices which was unexplained by six other independent variables. Analysis of variance was

used to discover whether (1) the Ontario grower's share of refiner's receipts from sugar sales were significantly higher in Period 2 than in Period 1, (2) the increase in the Ontario grower's share of such receipts in Period 2 compared to Period 1 were significantly higher than similar increases in the Alberta beet grower's share of refiner's receipts for the same time periods, (3) grower's receipts from the sale of sugar beet by-products were significantly higher in Ontario than in Alberta and Manitoba, and (4) grower's costs of operating the sugar beet associations in Alberta and Manitoba were significantly higher than the cost of operating the Ontario Sugar Beet Growers' Marketing Board. Analyses of the Ontario refiner's accounts were made to discover the effect that other variables had on the refiner's profits and to estimate how much of the sugar beet price increase in Period 2 could be attributed to the marketing board.

The results of the various analyses indicated that the marketing board had benefited Ontario beet growers. It was found to be a significant factor in explaining the variance in Ontario sugar beet prices. The Ontario grower's share of refiner's receipts from the sale of sugar were found to be significantly higher in Period 2 than in Period 1. However, when the increase in the Ontario grower's share of refiner's receipts was compared to similar increases in growers' share of refiner's receipts in Alberta, it was found that Alberta growers received the larger increase. When Ontario government subsidies were included in calculating Ontario growers' share of receipts, this significant difference disappeared. Ontario growers received a significantly higher price for beet by-products than did growers in Manitoba; however, the difference between Ontario and Alberta receipts was not significant. Although the cost of operating the marketing board was lower than the costs of operating sugar beet associations in Alberta and Manitoba, the difference was not significant. Analysis of the Ontario refiner's accounts revealed that from Period 1 to Period 2 receipts decreased by 59 cents per ton of beets, expenditures increased by 93 cents, and profits decreased by $1.52. The increases in three of the nine expenditures considered were balanced by decreases in three others. The only net increase in refiner's expenditures was the 93 cents going to farmers. Of this 93 cents per ton 45 cents was attributed to the presence of the marketing board.

The final conclusion was that Ontario sugar beet growers had benefited from the presence and operation of their marketing board. When costs of operating the marketing board were deducted, the net benefit was estimated at 42 cents per ton of beets or, in terms of 1957 beet yields, $4.66 per acre.

Microfilm $2.80; Xerox $9.60. 215 pages.

A STUDY OF SOME PLANT CHARACTERISTICS AND CONTROL OF BUR RAGWEED, FRANSERIA TOMENTOSA GRAY.

(L. C. Card No. Mic 59-4379)

Paul Frederick Sand, Ph.D.
The University of Nebraska, 1959

Adviser: Laurence Cutler Newell

Bur ragweed, Franseria tomentosa Gray, also commonly called white weed or lagoon weed, is a deep-rooted perennial. It is a native weed of the central states and occurs in central and western Nebraska, eastern Colorado, central and western Kansas, western Oklahoma and the panhandle of Texas. In 1951 bur ragweed was declared a primary noxious weed in Nebraska by the Director of the State Department of Agriculture.

In order to learn more about the growth and reproduction of bur ragweed, studies were initiated in the laboratory to test seed germination and to measure available carbohydrates in the roots. Reproduction by root cuttings was tested in the greenhouse and field, and the spread of individual clones was measured. Because bur ragweed generally grows in large patches, it is necessary to have an economical control for large areas. Experiments on control with 2,4-D were carried on at Lincoln, Nebraska as well as at Minden, Holdrege, and Bertrand, Nebraska, where bur ragweed is a major problem.

Bur ragweed emerges about April 15 in Nebraska, grows from one to three feet tall, and the entire plant is covered with fine white hairs, which give it a grayish-green appearance. It is monoecious; the male flowers are borne on the tips of stems and branches and the female flowers in the leaf axils. Reproduction takes place by roots and seeds. Plants spread by horizontal roots. Vertical roots exceed a depth of 6 feet, but horizontal roots were found in the upper 10 inches of soil. Bur ragweed seed germinated poorly and appeared to have a hard seed coat as well as an internal dormancy. Seed dormancy is an advantage in distribution and propagation of the weed although the major spread in a given area is through infestation of the surrounding area by lateral roots.

Total available carbohydrates in roots averaged 29 per cent. Starch was the most plentiful carbohydrate and averaged 20.1 per cent, while sucrose averaged 7.6 per cent and reducing sugars 1.2 per cent on the basis of 5.5 per cent moisture. Total carbohydrates of untreated roots declined steadily from emergence to May 21st and after that continued to increase, with some variation, until August. Treatments with 2,4-dichlorophenoxyacetic acid were effective in the spring shortly after the carbohydrates began to increase in the roots. The movement of 2,4-D in plants is related to the translocation of sugars which may explain why 2,4-D is not effective before food storage begins to take place in the roots.

New plants developed readily from root cuttings in both the greenhouse and field. Once established in the field, the clones spread rapidly by horizontal roots, and after a period of two years averaged 31 feet in diameter.

Timing and rate of application were two of the most important facts brought out by experiments with 2,4-D on control of bur ragweed. Applications in July were not as effective as in June, and treatment in August after carbohydrates stopped increasing in the roots was not effective.

Treatments that gave the most consistent reductions in stand were the 2 and 4 lb/A rates of isopropyl ester, the 1 and 2 lb/A rates of butoxy ethanol ester and the 4 lb/A rate of amine. For the best and most economical results, 2 lb/A of 2,4-D ester should be used in June. Repeated treatments with 2,4-D are necessary each year until desired control is obtained.

Microfilm $2.00; Xerox $4.20. 79 pages.

THE EFFECT OF DEODORIZED MILK FAT ON THE FLAVOR DETERIORATION OF DRY WHOLE MILK.

(L. C. Card No. Mic 59-5132)

Bruce Wilbur Tharp, Ph.D.
The Pennsylvania State University, 1959

An apparently non-oxidative flavor defect, usually characterized as "coconut-like," appears early in the storage life of dry whole milk. It has been shown to be caused by the presence of δ-decalactone. This investigation was conducted to determine: the extent to which the application of steam deodorization to milk fat can improve the flavor stability of dry whole milk; the effects of deodorization temperature on such improvement; and the chemical identity of certain components of the neutral fraction extracted from deodorization distillates.

Two drying trials were conducted. Gas packed, dry whole milk products, containing fat deodorized at various temperatures, were compared with a conventional dry whole milk manufactured from the same original lot of milk. Flavor evaluations of these products, by an experienced taste panel, were made periodically during storage. Results of these evaluations indicate that the samples containing deodorized fat constituted beverage products superior to the control dry whole milk. This superiority continued through seven months of storage. Results of one trial suggest that a deodorization temperature of 125°C., at an absolute pressure of 5.0 mm. Hg, brought about an improvement equal to that imparted by deodorization at higher temperatures. Products containing fat deodorized at 100°C. displayed a lesser improvement.

The most significant flavor difference between the products evaluated was the absence of the coconut flavor from samples containing fat deodorized at a temperature of 125°C. and above. This flavor was present in high levels in the conventional dry whole milks and, to a lesser extent, in the 100°C. deodorized sample. Analysis of distillates, obtained from re-deodorizations at 200°C., revealed an incomplete removal of δ-decalactone by initial treatments at 100°C. and less. These observations indicate that the principal cause of the improvement, imparted to dry whole milk by steam deodorization, is the formation and removal of δ-decalactone and associated flavor compounds.

The gross source of the "stale" flavor of dry whole milk was investigated. Dried products were manufactured from skim milk, skim milk with added buttermilk, and whole milk–all from the same lot of raw milk. Periodic evaluation of these gas packed products were conducted during storage, on the basis of typical dry whole milk staleness present. These evaluations show that a large extent of dry whole milk flavor deterioration, which occurs under low levels of oxygen, originates in the milk fat.

The neutral deodorization distillate material was fractionated by liquid partition column chromatography. Paper chromatography of the resulting fractions, before and after conversion to hydroxamic acid derivatives, revealed the presence of δ-decalactone and δ-dodecalactone, as well as butyrate, hexanoate, and additional ester radicals through a chain length of fourteen carbons. Chromatographic results, combined with infrared spectral analysis of the fractions, suggested the presence of tributyrin and trihexanoin. The possibility that the glyceride material might be mixed di- or tri-glycerides, containing the ester radicals identified, was not precluded.

The separation of a fraction with a lactone-like odor was observed. Its chromatographic behavior suggested a shorter chain length than δ-declactone. Lack of appropriate authentic compounds for comparison prevented the complete identification of this fraction.

This investigation establishes that the application of steam deodorization to milk fat represents a potential source of improvement in the flavor stability of commercial dry whole milk. Hypothetical translation of the pilot-scale results obtained, to the commercial scale, indicates that commercial application of the process might enable the use of a milder combination of conditions than those outlined. Microfilm $2.00; Xerox $5.00. 100 pages.

AGRICULTURE, ANIMAL CULTURE

THE ENERGY VALUE OF VARIOUS FEEDSTUFFS FOR THE YOUNG PIG.

(L. C. Card No. Mic 59-4506)

Billy Gene Diggs, Ph.D.
University of Illinois, 1959

These studies were undertaken to determine the energy value of various feedstuffs which are of economical importance for swine. In addition, simplification of productive energy studies was investigated by determining the feasibility of estimating the energy value of a live pig from its specific gravity. The first study was conducted to determine the productive energy value of lactose and to study the correlation between specific gravity of the live pig and its chemical composition and caloric density. Two rations which differed by the amount of lactose were individually fed at two levels to young pigs. By using the algebraic method proposed by Fraps and Carlyle (1939), the productive energy values of each ration and the maintenance requirement of the pigs were determined thereby allowing the productive energy value of lactose to be determined. It was found that the maintenance requirement of the pigs and the productive energy values of the rations varied considerably when this method was used and as a result the value for lactose varied beyond reason. By using a constant figure for maintenance, the productive energy values of the two rations and of lactose were recalculated and the variation was found to be greatly reduced.

An attempt was made to correlate the specific gravity

of the live pig with its energy value. The pigs were anesthetized with chloral hydrate and their volume was measured by determining the water displaced by each pig. The pigs were sacrificed by injecting air into the heart and subsequently were frozen, ground, sampled, and analyzed.

The specific gravity; percent water; percent fat; percent fat-free, water-free fraction; and the Calories per gram of pig were significantly affected by the level of feed intake and by the ration. The caloric density of the fat-free, water-free fraction was also significantly affected by the level of feeding.

The correlation coefficients for specific gravity of the live pig were 0.66, -0.73, and -0.64 with percent water, percent fat, and Calories per gram of pig, respectively. The correlation coefficients for percent water of the pig were -0.97 and -0.92 with percent fat and Calories per gram of pig, respectively. The correlation coefficient between percent fat and Calories per gram of pig was 0.90.

Regression equations were presented which would enable the caloric density of a live pig to be predicted from a knowledge of its fat or water content. Since the fat and water content of an animal were highly correlated, one could be calculated from a knowledge of the other; thus allowing the fat-free, water-free fraction to be determined. The caloric value of the fat fraction was 8.972 ± .082 Calories per gram and the caloric density of the fat-free, water-free fraction was 4.606 ± .092 Calories per gram.

In this study the specific gravity of the live pig was not sufficiently correlated with its energy content to establish it as a useful index of the Caloric density of an animal.

Six balance experiments were conducted with pigs averaging approximately 34 pounds. Digestible energy, metabolizable energy and metabolizable energy adjusted for nitrogen balance were determined for 18 feedstuffs.

Pigs which received a ration containing 35 percent protein or more excreted 6.77 Calories in the urine for each gram of urinary nitrogen. This factor was used to correct all metabolizable energy values for nitrogen gained or lost.

For the 18 feedstuffs studied the metabolizable energy averaged 94.7 ± 5.3 percent of the digestible energy, metabolizable energy adjusted for nitrogen gained or lost averaged 91.6 ± 6.3 percent of the digestible energy, and metabolizable energy adjusted for nitrogen gained or lost averaged 96.9 ± 1.7 percent of the unadjusted metabolizable energy.

The feedstuffs studied and the metabolizable energy values adjusted for nitrogen balance were as follows:

Feedstuff	Cal./gm.
Starch	3.606
Cerelose	3.262
Corn	3.248
Wheat	3.076
Oats	2.679
Milo	3.067
Wheat bran	2.184
Alfalfa meal	1.300
Rolled oats	3.470
Dried whey	2.926
Lard	7.535
Tallow	7.831
Corn oil	7.303
Lactose	3.341
Meal and bone scraps	1.557
Fish meal	2.695
Tankage	2.072
Soybean oil meal	3.390

Microfilm $2.00; Xerox $4.40. 81 pages.

METABOLIC ASPECTS OF UREA AND CARBOHYDRATES VERSUS PLANT PROTEIN FOR SHEEP.

(L. C. Card No. Mic 59-5293)

David Drori, Ph.D.
Cornell University, 1959

Three types of diets consisting of a basal of chopped timothy hay, molasses and minerals and supplements of (1) glucose, urea and sodium sulfate, (2) cornstarch, urea and sodium sulfate, and (3) soybean oil meal and corn were fed to sheep. The supplements provided 70% of the nitrogen of the diets.

Nitrogen balance was measured and the variation of several constituents of blood, rumen liquor and urine was investigated. The rapidity with which sheep consumed allotments after feeding were compared.

Blood constituents studied were: urea, nonprotein nitrogen, glucose, acetone and total ketone bodies. Rumen liquor constituents studied were: volatile fatty acids (acetic, propionic and butyric), copper reducing substances, dry matter, total nitrogen, ammonia nitrogen, organic nitrogen, nonprotein nitrogen and urea. Turbidity of rumen liquor was studied as a potential index of protein content.

When isocaloric diets were fed, a type 3 diet produced higher nitrogen retention and biological values than the other diets. Blood urea and nonprotein nitrogen values after feeding increased on diet 1 and 2 and decreased on diet 3. Rumen ammonia levels appeared to contribute to these differences. Urea was detected in trace amounts in 22 out of 56 samples of rumen liquor of sheep fed diets 1 and 2. Urinary urea excretion accounted for the differences in nitrogen retention.

Rumen liquor organic nitrogen concentrations, on an absolute or on a dry matter basis, and turbidities of rumen liquor showed no evidence of more bacterial protein or higher bacterial counts on diet 3 than on the other diets.

Blood acetone and rumen volatile fatty acids presented complementary results. Diet 1 had the lowest and diet 3 the highest ketogenic effect in terms of these metabolites. Blood glucose levels increased consistently after feeding on diet 3 only. In one experiment, blood glucose increased after feeding on diet 1.

Consumption rates of the urea-carbohydrate supplemented diets in the first 45 minutes after feeding were significantly slower.

The hypothesis that plant protein undigested in the rumen may give conventional diets the margin over urea diets and explanations for the lower rate of consumption of urea diets are discussed.

Microfilm $2.00; Xerox $4.80. 91 pages.

THE EFFECT OF ORGANIC AND INORGANIC SOURCES OF UNIDENTIFIED GROWTH FACTORS ON THE GROWING PIG.

(L. C. Card No. Mic 59-4152)

Dwain Leon Jeter, Ph.D.
Purdue University, 1959

Major Professor: W. M. Beeson

Research has indicated various crude materials contain factor(s), as yet unidentified, that stimulate the growth rate of animals fed nutritionally adequate diets. The growth response can not be duplicated with additions of any of the known required nutrients. To date, only a limited amount of research has been conducted with the pig to determine the effect of these unidentified growth factor sources on pig performance. Therefore, a series of experiments were designed to determine the effect of these growth factor sources on the early-weaned pig and to further characterize these factors. Growth stimulation was used as the criterion for detecting the presence of these accessory factors.

A total of 172 three-week-old pigs was used in a series of four experiments. The pigs were fed ad libitum a semi-purified diet and soft water for experimental periods of 42- to 56-days duration. A semi-purified basal diet composed of isolated soybean protein, corn starch, cerelose (glucose), corn oil, celluflour, DL-Methionine, minerals, vitamins and chlortetracycline hydrochloride was used in all experiments. Pigs were maintained in concrete-floored pens with two pigs per pen.

A diet containing 0.68 percent calcium and 16 parts per million zinc was inadequate for normal growth, and a high incidence of parakeratosis developed. Fifty parts per million supplementary zinc resulted in normal growth and completely prevented parakeratosis. The ash of brewers yeast significantly increased growth rate and partially alleviated parakeratosis, but performance was below normal. The response was not attributed to the zinc contained in the ash. Additions of distillers solubles, the ash of distillers solubles, a reconstituted ash of distillers solubles, brewers dried yeast, or selenium were without effect in the low-zinc diet. These results indicate the growth factor response obtained with crude products is not due to zinc.

In three separate experiments, five percent distillers dried solubles improved the growth rate of pigs fed a semi-purified diet containing adequate zinc (69 p.p.m. total). Growth rate was increased 4.7 to 17.3 percent, and feed efficiency was improved in two of the three trials.

Refluxing distillers solubles in methanol resulted in partial extraction of the activity therein. Responses of 4.7 and 13.5 percent were obtained with the methanol extract in two separate trials. The response obtained was less than that obtained with the crude product, and the methanol-insoluble fraction also gave a response indicating distillers solubles contains more than one pig growth factor or that the extraction procedure failed to remove all of the factor. The sums of the responses obtained with the methanol-soluble and insoluble fractions of distillers dried solubles were greater than those obtained with the crude product indicating liberation of a bound form of the pig growth factor in distillers dried solubles by methanol extraction.

Partitioning the methanol extract of distillers solubles between chloroform and water gave inconclusive results. Slight, but insignificant, increases in growth rate were obtained with both the chloroform and water soluble fractions.

A study of the inorganic fraction of distillers solubles was made in two experiments. The ash of distillers solubles increased feed efficiency in both trials and had no effect on growth rate in one trial, and in a second trial the ash increased growth rate 8.6 percent which was approximately one-half that obtained with the crude product. A reconstituted ash of distillers solubles gave inconclusive results since the experimental data was unavoidably confounded in the lots receiving this preparation.

Pigs fed a diet containing 0.68 percent calcium and 69 parts per million zinc did not respond to additions of five percent brewers dried yeast or the ash of brewers yeast indicating brewers yeast is a poor source of the growth factor for the pig.

Strontium or selenium did not appear to be the elements responsible for the inorganic growth response.

A leg deformity, resembling rickets, occurred under the conditions of this experiment. This condition was apparently alleviated by distillers solubles; however, other sources of unidentified growth factors or the ash of distillers solubles were without effect. Data indicated body stores of the growth factor, maternal origin and live-weight influenced the occurrence of this condition.

When the experimental pigs were fed the basal diet for a two-week depletion period and when the data obtained during this period were used as another criterion for allotment into experimental treatments, the sensitivity of the biological assay for the growth factors, using the pig as the experimental animal, was enhanced. Thus, body depletion of growth factors was indicated. Depletion appeared to be a useful tool in growth factor assay work.

Microfilm $2.00; Xerox $6.40. 131 pages.

THE EFFECT OF CERTAIN FACTORS ON MOISTURE, PROTEIN, THREONINE AND OTHER COMPONENTS OF HENS' EGGS.

(L. C. Card No. Mic 59-4165)

Kenneth Nathaniel May, Ph.D.
Purdue University, 1959

Major Professor: W. J. Stadelman

Various hen egg components, including egg weight, shell weight, egg contents weight, albumen height, Haugh units, percent moisture, percent protein in fresh eggs, percent protein in dry egg, percent threonine in fresh egg, milligrams of threonine per egg and grams of protein per egg were studied under various conditions to determine possible changes due to induced factors. Factors studied included strain of chicken, age of hen, time of year, age of egg, cooking of egg, high protein ration for diet of hen and high threonine ration for diet of hen. Moisture determinations were made using a 36 port freeze dryer. Protein was determined using the micro-Kjeldahl method while threonine was determined by the periodate method.

Strain of chicken was shown to have a significant

influence on albumen quality, loss of albumen quality, percent moisture in the egg, percent protein in the egg (both wet and dry basis) and, in some cases, grams of protein per egg. Strains tested included strains from White Leghorn, Rhode Island Red, White Plymouth Rock and Hoosier White breeds. No strain by time (or season) effect was noted for any variable except, possibly egg weight and egg contents weight which were significant in one trial.

Pullets within strains were found to differ significantly for every variable studied.

Age of hen (or season) was found to significantly affect egg contents weight, albumen height, Haugh units, percent moisture, percent protein in dry egg and grams of protein per egg.

With limited numbers, rations with high protein or high threonine content did not affect the protein or threonine content of the egg. Cooking had no effect on the protein or threonine content of eggs under the conditions used.

Mean percentage protein was found to be about 13 percent while mean grams of protein per egg was about 7.0 gm. Mean percentage threonine of egg protein was about 4.0 percent and mean milligrams of threonine per egg was about 250 milligrams per egg. Threonine was found to decrease in stored eggs both in percent and in actual weight.

Positive significant correlations were shown for: egg weight x egg contents weight (r=0.945); egg weight x grams of protein per egg (r=0.625); albumen height x shell weight (r=0.269); albumen height x Haugh units (r=0.714); percent moisture x egg contents weight (r=0.359); egg contents weight x grams of protein per egg (r=0.544); egg contents weight x percent protein in fresh egg (r=0.645); percent protein in dry egg x grams of protein per egg (r=0.670); and percent protein in fresh egg x grams of protein per egg (r=0.721). Negative, significant correlations were shown for: percent moisture x grams of protein per egg (r= -0.255); and percent moisture x percent protein in fresh egg (r= -0.475).

Microfilm $2.00; Xerox $5.20. 102 pages.

EFFECTS OF FOLIAR APPLICATION OF UREA ON THE NUTRITIVE VALUE OF SOME GRASS HAYS.

(L. C. Card No. Mic 59-5296)

William George Merrill, Ph.D.
Cornell University, 1959

Published experimental results show that soil applications of nitrogen to grasses have little, if any, effect on the nutritive value of the hay, except for an increased apparent digestibility of crude protein due to an increased crude protein content. Similar effects are produced by supplementing a diet of grass hay with urea at the time of feeding. However, it has been reported that applying urea to the foliage of growing grasses greatly increased the digestibility of the cellulose, dry matter and crude protein of the hay. However, these observations were obtained by using in vitro procedures and the hay was not fed to animals.

The experiments reported here were planned to further evaluate the effects of foliar application of urea on the chemical composition and nutritive value of some grass hays. The grasses used were second growth reed canary-grass and early- and late-cut timothy. Also included in these studies were timothy hays which had been fertilized by soil application of urea and early-cut timothy hay which was supplemented with urea at the time of feeding.

The nutritive value of the hays was measured (1) primarily by digestion trials with sheep and young bulls, (2) by an "in vivo" technique in which samples of the dry forage were exposed to the digestive action of the microorganisms of a rumen-fistulated steer and (3) by an in vitro rumen fermentation procedure.

In all cases, soil and foliar applications of urea increased the crude protein content of the hay and consequently increased the apparent digestibility of the crude protein. Supplementing the unfertilized hay with urea at the time of feeding also increased the apparent digestibility of the crude protein equivalent (N x 6.25) of the diet. This effect occurs whenever the crude protein content of any natural diet is increased and is not due to a change in the quality or availability of the protein. No change in the true digestibility of the crude protein in these hays would be expected.

Most of the experiments carried out here were not extensive enough to detect small differences among the digestibilities of nutrients in these hays. However, when all of the data were considered, there was no indication of any significant difference in the digestibility of any nutrient, except crude protein, among hays which were (1) unfertilized or not supplemented with urea, i.e. the control hay, (2) fertilized by foliar application of urea, (3) fertilized by soil application of urea or (4) supplemented with urea at the time of feeding.

Microfilm $2.00; Xerox $4.60. 90 pages.

MINERAL REQUIREMENT OF THE CHICK WITH SPECIAL REFERENCE TO ZINC AND MAGNESIUM.

(L. C. Card No. Mic 59-4541)

Max Walter Albert Moeller, Jr., Ph.D.
University of Illinois, 1959

The zinc requirement of the young chick was investigated using three purified-type diets. Beside amino acid supplementation the sole source of protein in the diets was (1) isolated soybean protein (Drackett Assay Protein C-1), (2) dried egg white, and (3) casein respectively. When measured in terms of optimal growth and feed conversion, the growing chick required 27-31, 10-12, and less than 14 p.p.m. (parts per million) zinc respectively for the Drackett, dried egg white, and casein diets. The respective basal diets analyzed 13, 2, and 14 p.p.m. zinc. Since the total zinc requirement on the egg white diet was 10 to 12 p.p.m., it appears that in addition to the zinc not being fully available in Drackett Protein, this protein contains a factor which accentuates the requirement for zinc. The actual zinc requirement of the young chick appears to be between 10 and 14 p.p.m. Stunting of growth was the only deficiency symptom observed during the first two weeks.

Growth was strikingly impaired early in the life of the chick when the diet was deficient in zinc. The concentration of zinc in the skeleton (tibia) paralleled the dosage

level. While significant statistically, only small differences were detected in the zinc content of the liver. The concentration of zinc in the diet was not correlated with the zinc content of juvenile feathers growing in the wing. Therefore, a chick bioassay for determining the availability of the zinc in poultry feedstuffs was developed based on average weight and the concentration of zinc in the tibia following a short feeding period in which graded levels of the feedstuff were incorporated in the diet to furnish three levels of zinc below the requirement level. The response to these levels of zinc from natural feedstuffs was compared with a $ZnCO_3$ standard. Under the conditions of this assay the zinc present in soybean meal and cornmeal was less available than the zinc present in $ZnCO_3$, while the zinc present in distillers dried solubles was equal to or more available than the zinc present in $ZnCO_3$.

In a concurrent zinc balance trial the young chick retained about 50 percent of the zinc ingested when the percentage of zinc in the diet approached the requirement level. Negative balances were noted on diets severely deficient in zinc, and somewhat elevated retention values (67%) were noted on diets containing excess amounts of zinc.

The magnesium requirement of the young chick was also investigated. With the Drackett diet the magnesium requirement for survival of the chick and maximum growth was 400-465 p.p.m., and with the casein diet the requirement was between 390-470 p.p.m. The observed magnesium deficiency symptoms included: poor growth, hyperexcitability, anorexia associated with excessive water consumption, squatting, and death.

Microfilm $2.00; Xerox $5.40. 109 pages.

STUDIES ON RUMEN VOLATILE FATTY ACID PRODUCTION.

(L. C. Card No. Mic 59-4570)

Alan Jonathan Sheppard, Ph.D.
University of Illinois, 1959

Experiments employing isotope dilution in the rumen of fistulated sheep have been conducted leading to the determination of the rate of acetate production. A ration of all-clover hay was fed with a mineral mix and water free choice. The concentrations of the volatile fatty acids have been observed over varying periods of time up to 24 hours following feed ingestion. The effect of trimethylalkylammonium stearate on the volatile fatty acid concentration in the rumen has been observed.

A partition chromatographic technique based on Celite 535 and a butanol-hexane solvent system was employed to separate and measure quantitatively butyrate, propionate, acetate, and the higher fatty acids.

Acetate-1-C-14 was introduced into the rumen and its disappearance and dilution observed in the terminal experiment. The rate of acetate disappearance was calculated from the decrease in acetate radioactivity and the rate of acetate production was calculated from the decrease in acetate specific activity. The transfer of carbon-14 by the rumen microorganisms was also observed.

From the data obtained, the conclusions are:

1. The relative molar percentages of the volatile fatty acids were remarkably constant and independent of the total volatile fatty acid concentration. The percentages were, on the average, 71.2 acetate, 19.5 propionate, and 9.3 butyrate.
2. Two peaks of volatile fatty acid concentration occurred during the 24-hour period following feed ingestion at approximately 5 and 12 hours. A depression in concentration occurred at approximately 9 hours.
3. The levels of volatile fatty acids were significantly lower in the rumen when the animals were conditioned with trimethylalkylammonium stearate. However, when initial acid levels were taken into consideration, the presence of the compound made no difference in accumulation of acids following feeding.
4. The apparent mixing time of added radioacetate in rumen contents, on the average, was less than one hour.
5. Acetate production during a 7-hour period of descending rumen volatile fatty acid concentration was 0.126 mMoles per mMole of rumen liquor, which amounted to 28.7 percent of the maintenance requirement of a 140-pound sheep.
6. Acetate disappearance during a 7-hour period of descending volatile fatty acid concentration was 0.139 mMole per milliliter of rumen liquor.
7. The labeled carbon of acetate was found in rumen CO_2 and CH_4.
8. Labeling of the volatile fatty acids was found as follows: acetate butyrate propionate higher fatty acids.
9. Data derived from a single isotope dilution are applicable for the determination of the rates of production and disappearance of the added acid over only the segment of the cycle of volatile fatty acid concentration during which the data were obtained.
10. Further isotope dilution experiments need to be conducted to complete the production data for acetate over a 24-hour period as well as additional experiments to determine production data for the other fatty acids.

Microfilm $2.00; Xerox $5.00. 100 pages.

PREFERENCES OF CATTLE FOR CERTAIN FLAVORS AND THEIR EFFECT ON PALATABILITY OF SALT MIXTURES.

(L. C. Card No. Mic 59-5290)

Owen James Stubbs, Ph.D.
Cornell University, 1959

Since the intakes of salt and phenothiazine mixtures by cattle have been found to be highly variable, an attempt was made in this study to locate substances highly palatable to cattle which could be advantageously used in inducing them to consume more feed, salt mixtures or drugs than they normally do. At the outset experiments were conducted to test the palatability of soluble substances which held promise as suitable flavoring materials.

Methods of testing possible materials were investigated and a system of testing palatability in the drinking water with a two-pail system was followed. Eight to sixteen week-old dairy calves were mainly used and each calf was offered a choice of plain distilled water and a flavored solution for a period of 5 to 10 days. The daily proportions

of flavored solution consumed by each calf were measured and expressed as a percentage of total fluid intake. Control calves receiving plain water in both pails were used in each experiment.

Preliminary trials showed that cattle, under the conditions of these experiments, generally preferred 1 to 2% solutions of sucrose to plain water and severely discriminated against 0.05 - 0.1N HCl and 0.1% quinine solutions. The responses to 0.5 and 1.0% Na Cl solutions showed an age effect with calves appearing to discriminate less than older cattle.

Three experiments with saccharin indicated that calves are indifferent to dilute solutions of this synthetic sweetening agent. An experiment to compare the palatability of sucrose- and molasses solutions resulted in the calves varying in their preferences for these solutions.

Spraying good-quality hay with solutions of sucrose or saccharin in a reversal-type experiment did not increase the consumption of hay by 3 groups of dairy heifers over that of hay sprayed with water.

A survey of the literature on the free-choice consumption of salt and mineral mixtures by cattle showed that the intake was highly variable and ranged from 0.1 to 4 or more ounces per day. The few reports available also show that when phenothiazine is added to salt mixtures, the free-choice consumption by cattle is greatly reduced.

The results of numerous experiments carried out at this station with salt and phenothiazine mixtures containing a host of additives in an attempt to increase the palatability of the mixture are presented.

Instead of the desired level of intake of 1 oz. of mixture per day which would insure a 2 gm. dose of phenothiazine for anthelmintic purposes, most mixtures tested under winter barn-feeding conditions were only consumed at the rate of about 0.10 to 0.40 oz. per day. Without the addition of phenothiazine consumption of salt mixtures ranged from 0.18 to 1.33 oz. per day. It seems clear that an additive which is capable of masking the unpalatable effect of phenothiazine has not yet been discovered and in the light of present knowledge carob flour, dehydrated molasses or sugar seem to be most satisfactory.

The results of a reversal type experiment carried out with Hereford calves during the winter barn-feeding period showed that the addition of trace-minerals and an ultramarine-blue coloring material to plain salt did not reduce consumption of the salt. This and other trials indicated that sugar may have promise as a suitable additive for promoting palatability.

A series of micro-photographs was taken of bovine papillae and taste buds. Taste buds were observed only in the lateral walls of the vallate papillae.

Microfilm $2.00; Xerox $4.60. 89 pages.

LABORATORY STUDIES ON SILAGE FERMENTATION.

(L. C. Card No. Mic 59-4186)

Billy Jean Walker, Ph.D.
Purdue University, 1959

Major Professor: Donald L. Hill

Laboratory silages were prepared by placing 2 to 3 pounds of freshly chopped forage into a saran plastic bag, vacuumizing to 15 inches of Hg to remove air and sealing with aluminum clamps. The fermentations which occurred were typical for the forages and additives used. Mold growth was not observed in any of the intact silos.

A modification of the silica gel chromatographic method of Harper (41) was used to determine the volatile acids in silages. Using this method, the average recoveries for acetic, propionic and butyric acids were 96.9%, 98.1% and 97.3%, respectively.

The acidified silica gel method of Bulen et al. (27) was modified for the estimation of lactic acid in silage. The average recovery of lactic acid using this method was 99.8 per cent.

Two laboratory experiments were conducted to determine the influence of stage of maturity and type of additive on the fermentation of grass legume silage. In the first experiment, second-cutting alfalfa was ensiled in the early bud, late bud, 1/10-bloom, 1/2-bloom and full-bloom stages of maturity. First-cutting alfalfa-bromegrass harvested at comparable stages of maturity was used in the second experiment. Treatments used in both experiments were control, sodium metabisulfite (8 lbs. per ton) and black-strap molasses (80 lbs. per ton).

Duplicate silos were opened for sampling 2, 4, 8, 16, 32, 64 and 128 days after ensiling in experiment 1. The 128-day sample was omitted in experiment 2. Titratable acidity and pH measurements were made on all samples. The 32- and 128-day samples in experiment 1 and the 16-, 32- and 64-day samples in experiment 2 were analyzed for acetic, propionic, butyric and lactic acids.

None of the experimental silages contained detectable amounts of propionic acid. Butyric acid was found only in the untreated silages, the level decreasing with advancing stage of maturity.

In general, the first-cutting alfalfa-bromegrass produced a more desirable fermentation than the second-cutting alfalfa. The silage fermentation also improved with advancing stage of maturity in each case. These effects, though evident in the control silages, were almost completely masked by the use of additives.

Treatment with molasses or sodium metabisulfite modified the fermentation of all silages, especially those harvested at the earlier stages of maturity. Both of the additives were effective in preventing the formation of butyric acid and the development of putrefactive odors characteristic of the pre-bloom control silages. The addition of molasses resulted in a vigorous lactic acid fermentation while sodium metabisulfite inhibited acid production, especially during the early fermentation. The sodium metabisulfite-treated silages appeared to be well preserved in spite of low levels of lactic acid.

Correlation coefficients indicated that pH and/or titratable acidity may be as useful as lactic acid content in evaluating natural silage fermentations. However, these

estimates of acidity were not adequate for determining the degree of preservation of sodium metabisulfite-treated silages. These findings point out the need for methods suitable for evaluating silage fermentations which have been influenced by bacteriostatic materials, nutrient addition or by wilting.

Microfilm $2.00; Xeros $6.00. 123 pages.

AGRICULTURE, FORESTRY & WILDLIFE

THE INFLUENCE OF SEASON AND TEMPERATURE ON GROWTH OF THE BLUEGILL, LEPOMIS MACROCHIRUS RAFINESQUE.

(L. C. Card No. Mic 59-4875)

Richard Orr Anderson, Ph.D.
University of Michigan, 1959

The purpose of this investigation was to determine and measure the importance of factors producing seasonal growth periodicity observed in the bluegill. Individual fish were fed mealworms in feeding cages at Third Sister Lake, Washtenaw County, Michigan, for a 16-month period (August, 1956 through December, 1957). Others were fed in the laboratory at uniform temperatures (50°, 60°, 70°, and 80° F) at different seasons (February 16 to March 16, May 30 to June 28, August 15 to September 13, November 26 to December 25). Measurements included rate of food consumption, growth in length and weight, and food conversion. In addition, absorption and growth coefficients for protein, fat, and energy were determined in the laboratory experiment.

The season for growth in 1957 at Third Sister Lake included the 6-month period from May through October. In the months from January to April and November to December the average weekly ration (weight of food consumed x 100/body weight) was only 0.5 percent; fish lost a small amount of weight and showed no increase in length. The percentage of the average annual length increment completed and average temperature in each month were: May, 16, 61° F; June, 29, 73° F; July, 25, 76° F; August, 12, 77° F; September, 14, 68° F; and October, 4, 54° F. The weight increments and rate of food consumption followed a similar pattern. The average weekly rations (in percent) were: May, 18.6; June, 20.7; July, 19.5; August, 6.5; September, 9.4; and October, 2.9.

In laboratory experiments there were statistically significant seasonal differences in appetite and growth at uniform temperatures of 60° F and above. The highest rates (combined average for 70° and 80° F) of food consumption and growth were in June (30.1 percent per week, 14.1 mm per month); the lowest average rates were in late summer (15.6 percent per week, 6.6 mm per month). An endocrine mechanism from the pituitary (growth hormone) is suggested as the seasonal factor causing the variability at uniform temperatures. The growth pattern at Third Sister Lake is attributed to an interaction of temperature and the seasonal factor.

The highest seasonal food conversion coefficients (amount gained x 100/amount consumed) were at the highest rates of food consumption in June. The average coefficients (in percent) at each temperature (50°, 60°, 70°, 80° F) for all seasons combined were, respectively: weight, 24.1, 32.0, 39.9, and 39.5; protein, 14, 35, 35, and 42; fat, 35, 32, 42, and 47; energy, 25, 32, 42, and 47.

At 50° F the average rate of food consumption and growth in weight and length in the laboratory for all seasons was low (9.3 percent per week; 1.3 gm, 1.1 mm per month). At 80° F rate of food consumption was approximately three times as high (25.5 percent); average weight and length increments, however, were increased six- and tenfold respectively (7.2 gm and 11.6 mm).

Seasonal differences in growth potential are not directly due to differences in day length. Groups of fish exposed to short (10-hour) and long (15-hour) photoperiods at 80° F over a 30-day interval during February and March exhibited similar average rates of food consumption (26.7, 27.9 percent) and growth (10, 11 mm; 10.7, 10.0 gm).

Observations indicate that there is a difference in the relationship between growth in length and weight at different rates of food consumption. Related to problems of fish production, calculations indicate that peak rate of fish production (pounds per acre per year) may occur in an environment at a population level at which growth in weight of individual fish is less than the potential but where growth in length is maximal.

Microfilm $2.00; Xerox $6.60. 140 pages.

NATURAL VARIATION AND CLONAL DEVELOPMENT OF POPULUS TREMULOIDES AND P. GRANDIDENTATA IN NORTHERN LOWER MICHIGAN.

(L. C. Card No. Mic 59-4882)

Burton Verne Barnes, Ph.D.
University of Michigan, 1959

The purposes of this study were first, to analyze the clonal aspects of the ontogeny of Populus tremuloides and P. grandidentata; second, to study the nature and extent of variation of these aspen species in several morphological and physiological characters; and third, to develop techniques by which members of one clone may be distinguished from those of another clone of the same species.

Aspen colonies (each a putative clone) were selected for study on two relatively uniform sites in the University of Michigan Biological Station Forest near Pellston, Michigan. Fave sample trees were systematically selected in each of 31 P. tremuloides and 21 P. grandidentata clones of both sexes. Leaf samples from three different shoot lengths, and data on total height, age, crown class, and diameter breast height were collected from each sample tree. Phenological data were obtained in the fall, 1957, and spring and fall, 1958.

The aspens are of particular biological interest in that they occur naturally in colonies, each an independent clone composed of many plants of the same genetic constitution. Since seedlings are rare or absent on many sites over much of the range of the two American species, the development of these clones is of great silvicultural

significance. The ontogeny of the clones was studied by analyzing their establishment, form and structure, age, growth pattern, and root system. In an excavation of the root system of part of one clone, many stems were found connected on a complex root system. There was, however, no predictable arrangement of suckers on the root system.

A wide range of interclonal variation was observed in the clones' suckering ability, growth capacity, stem form, leaf flushing, fall leaf coloration, leaves, bark, and bracts of the flowers. Minor fluctuations within clones, probably correlated with environmental factors, occurred in the gross appearance of the clone members and in certain specific morphological characters.

The interclonal differences in sex, time of flushing, fall leaf coloration, leaf characteristics, et al., are great enough to permit members of one clone to be distinguished from those of a neighboring clone of the same species. Clones whose characteristics closely resembled approximately 16 previously described subspecific aspen taxa were observed on the two research sites. Two clones of the alba-tremuloides hybrid, one clone of the alba-grandidentata hybrid, and 33 clones of the grandidentata-tremuloides hybrid were discovered during the course of the study.

Three general conclusions can be drawn from this study. First, the clone is the typical growth habit of the aspens in Lower Michigan rather than the single stem typical of most tree species. The clonal habit of growth has definite implications in forest tree improvement and in silvicultural research. Second, the aspens exhibit a surprisingly great amount of interclonal variation in a number of characters even in a fragmentary part of their range. Thus, a broad concept of the two aspen species which recognizes the great diversity existing in Michigan (and likely throughout the range of both species) should be adopted. Third, members of one clone can usually be distinguished readily from those of a neighboring clone by a variety of morphological and physiological characters.

Microfilm $4.30; Xerox $14.40. 334 pages.

THE GROWTH AND YIELD OF RED PINE IN MINNESOTA.

(L. C. Card No. Mic 59-4890)

Robert Erwin Buckman, Ph.D.
University of Michigan, 1959

Growth data from permanent sample plots are used to construct a regression equation for predicting the growth and yield of red pine (Pinus resinosa) in Minnesota. The study has two purposes: First, to predict the growth and yield of red pine as such; and second, to examine methods of constructing growth and yield prediction schemes.

Some 324 growth periods are available from 235 permanent sample plots contained in 14 separate experiments. A number of plots have been measured more than once but each measurement period has been treated as a separate observation. Likewise, a number of plots are adjacent to one another. These considerations raise questions of statistical independence between the growth periods. The end result of this is that significance levels are likely to be higher than they actually are in the population of red pine.

For purposes of this paper growth is synonymous with net periodic annual increment. Yield is the summation of any number of these annual growth increments.

The important variables for predicting growth from this body of data are age, site index, and stand density. Variables that were considered but bore no apparent relationship to growth were intensity of cutting, number of trees per acre, cutting methods, and variability of tree diameters.

The equation for predicting basal area growth per acre per year is $Y = 1.6889 + .041066X_1 - .00016303X_1^2 - .076958X_2 + .00022741X_2^2 + .06441X_3$ where Y is basal area growth, X_1 is stand density in basal area per acre, X_2 is age in years, and X_3 is site index.

Growth tables were prepared for basal area, cubic feet, and cordwood for site indices 45, 50, 55, and 60; for ages 30 through 160; and for stand densities of 60, 90, 120, 150, and 180 square feet of basal area per acre. Board foot growth tables were prepared for the same conditions except that younger ages were omitted.

Cubic foot, cordwood, and board foot growth tables were prepared by substitution of basal area from the above growth function and height from site index curves into the following stand volume equations:

$$V_{cu.ft.} = .4085 \quad B \cdot H$$
$$V_{cords} = .003958 \quad B \cdot H$$
$$V_{bd.ft.} = 2.084 \quad B \cdot H$$

where V is volume per acre, B is basal area per acre, and H is the average total height of dominants and codominants.

Yield tables were prepared for two kinds of forest management: the first, called average density management, has stand density averaging a chosen level midway through a 10-year cutting cycle; the second, called constant beginning density management, starts each decade with the same density. Site index 50 red pine stands with densities of 90, 120, and 150 square feet of basal area per acre were used as examples of these yield tables.

Because growth is predicted in basal area and because numbers of trees per acre are apparently independent of growth (after the effects of stand density as measured in basal area per acre are removed) future tree diameters can be predicted. This requires two assumptions: first, the tree of average basal area is not changed by cutting; second, there is no mortality. If these assumptions are fulfilled one can then determine the number of trees per acre, choose a certain management schedule, and then predict the tree of average basal area at any time up to 160 years of age.

Microfilm $2.00; Xerox $6.80. 141 pages.

SOME BIOLOGICAL ASPECTS OF PURE AND MIXED CONIFEROUS PLANTATIONS IN LOWER MICHIGAN.

(L. C. Card No. Mic 59-4937)

Mohammad Sulaiman Kakli, Ph.D.
University of Michigan, 1959

This study attempts an evaluation of pure versus mixed stands. The first part includes a history of the controversy, an examination of the advantages and disadvantages claimed for both types, and a statement of the present status of the problem. This section is based on both American and foreign literature dating as far back as the year 1500.

The second part is an examination of the growth and development of a number of 35-year-old pure and mixed (alternate row) plantations of jack pine, red pine, Scotch pine, and white pine in Lower Michigan. The purpose is to compare the development of these species when grown in mixture and when grown in pure stands. Their development both as individual trees and as stands is considered. The pure and mixed plantings are compared from the standpoints of growths in diameter, height, and volume, of survival, and of insect and disease attacks.

An examination of the literature dealing with the relative advantages of planting in pure or mixed stands yields the conclusion that the choice between the two should be based on specific conditions in a given area.

Whereas on all sites jack pine survives as well in pure stands as in mixture with the other species, survival of red pine on medium and poor sites is adversely affected by mixture with jack pine. Scotch pine suffers loss in survival in mixture with jack pine on all sites and with red pine on good sites. Both jack pine and red pine appear to lower the survival percentage of white pine on all sites. Survival is highest in the case of jack pine and red pine, and lowest in that of white pine.

The height-growth of jack pine, red pine, and Scotch pine does not suffer in mixtures, but jack pine and red pine seem to limit height-growth of white pine on all sites. Jack pine and red pine, though not themselves affected in diameter-growth by mixture, appear to curb the diameter-growths of Scotch pine and white pine. Mixing seems to have no effect on the volume-growth of jack pine, but in the case of red pine, mixture affects volume-growth adversely on good sites.

Both jack pine and red pine reduce volume-growth of Scotch pine on good sites, and jack pine exerts such influence on medium sites also. White pine in mixture with jack pine, red pine, and Scotch pine on good sites, and with jack pine and red pine on medium sites, shows loss in volume-growth.

When trees are engaged in direct competition, red pine curbs the growth of jack pine on good sites, while red pine in turn suffers from direct competition with jack pine on medium and poor sites. Both Scotch pine and white pine show negative effects from direct competition with jack pine and red pine.

Evidences of attack by white pine weevil, spruce budworm, sawflies, pine spittlebug, Saratoga spittlebug, Nantucket pine tip moth, white pine rust, and sweet fern rust were found in the plantations. The incidence of attack on a less susceptible species seems to increase when it is mixed with a more susceptible species.

The following recommendations are made: (1) the four species should not be grown in alternate row mixtures; (2) jack pine should be limited to poor sites only; (3) red pine is recommended for good and medium sites; (4) white pine and Scotch pine are not recommended for the area studied. Microfilm $3.35; Xerox $11.40. 259 pages.

STUDIES IN THE ROOT GROWTH OF RED PINE (PINUS RESINOSA, AIT.).

(L. C. Card No. Mic 59-4958)

Clair Merritt, Ph.D.
University of Michigan, 1959

The purpose of this research was to explore the respective roles of environment and heredity in determining root-growth patterns in a species of forest tree. To obtain necessary control over the environment, the work was conducted in climate-control chambers and greenhouses. Selected two-year-old seedling stock of red pine (Pinus resinosa, Ait.) was used throughout the study.

Observations were made on root elongation and numbers of roots active in seedlings growing in glass-sided boxes in a 70°F., 16-hour photoperiod. Red pine root systems were found to possess a pattern of growth conforming closely to the usual seasonal changes in natural environments.

Tests on the nature of this pattern were made using both soil- and solution-cultured seedlings grown in greenhouses and control chambers. The latter included combinations of 80°F., 70°F., and 60°F. temperatures with 24-hour and 16-hour photoperiods. Manipulations of soil moisture content were made on one group of seedlings.

Results showed consistently that the basic pattern of red pine root growth is inherently controlled. However, environmental variations produced quantitative changes in root growth and influenced the timing of events. For example, increases in temperature from 60°F. to 80°F. effected proportional decreases in elapsed time between the beginning of growth and the period of greatest activity. On the other hand, these same temperature increases resulted in quantitative reductions in total growth.

Analysis of growth activity revealed evidence of short-term cycles in new-root initiation and in root elongation. Cycle lengths generally varied from 12 days to 4 days.

Within the same root system individual roots showed wide variations in growth rate. Times of growth initiation and cessation (in terms of elongation) also were extremely variable. As a result, dormant roots were found at all times during the study.

Investigations were made of growth relationships between roots and shoots of the same plant. Shearing needles to varying length showed that spring root growth is strongly dependent on needles of the previous year. Growth was directly proportional to the amount of needle tissue left intact. Little effect was obtained by removing the terminal bud.

Reactions of root and shoot elongation to environmental change were dissimilar. Root growth showed a close correlation to the average 24-hour temperature, while the growth of shoots was more nearly correlated to dark-period temperatures.

This investigation has demonstrated the existence of inherent rhythms in root growth of the red pine and that these are only partially modified by environmental variations. It is evident that studies of root growth characteristics must be conducted under controlled conditions.

Microfilm $2.00; Xerox $6.40. 135 pages.

THE NATURAL HISTORY OF THE ZIMMERMAN PINE MOTH (DIORYCTRIA ZIMMERMANI (GROTE)).

(L. C. Card No. Mic 59-4976)

Robert Gossett Rennels, Ph.D.
University of Michigan, 1959

The purpose of this study is to fill gaps in our knowledge of the natural history of the zimmerman pine moth as reported in the literature and to assay some of the principal ecological conditions characteristic of infested and uninfested trees and stands.

In the first phase of the study, screened cages were used to rear moths from larvae and pupae collected in the field. Observations and study of these moths provided the desired biological information.

Oviposition of mated females was observed in screen-covered glass jars and in small wire-screen cages fastened to tree trunks. Fecundity was determined in part by dissecting gravid females, and in part by oviposition experiments with moths in captivity. After death each was dissected to determine the number of fully developed eggs remaining in the ovaries.

In the second phase, 15 plantations were studied intensively in Winnebago and Ogle counties in Illinois. They represented variations in age, composition, stand density, and soil. One-tenth-acre circular plots were laid out systematically in each plantation. Data collected from individual trees and for plantations were recorded on mark-sense cards. Later these were transferred to I.B.M. cards for machine processing.

Information on population trends during the life of the trees were reconstructed from eighty-one cross sections of heavily infested Scotch pine trunks taken from the plantations. The resin impregnated ring at the point of each attack indicated accurately the season when each attack occurred.

The life history of the moth, in Illinois is as follows: The pupal stage occurs during the latter part of July and the first part of August requiring about 15 days. The peak of adult emergence is during the first two weeks of August. Mating follows within a day or two and oviposition begins in from 2 to 3 days later. The sexes are approximately equal in number, the sex factor for the several hundred that were reared being 0.545. The maximum number of eggs produced was 82. Therefore, assuming that this maximum approximates the reproductive capacity of the species, the reproductive potential for this insect with its single annual generation may be expressed for a single insect as 44.69.

All pines may be attacked but certain exotics such as Scotch pine seem to be more favored and more seriously damaged than most native pines. The moths attack both leading shoots and the trunks resulting more frequently in deformation than in mortality of the trees. Usually the point of attack is between 6 and 15 feet above the ground. Infestation is somewhat more frequent on the south and west sides than on the north, presumably due to differences in solar exposure.

The most significant conditions influencing the severity of infestation seem to be stand density and distance from a source of infestation. The percentage of infestation is highest in opengrown stands and apparently is increased by pruning the trees.

Fresh resin masses indicate active infestations and annual examination of the number in succeeding years provide a means for determining the rate of spread within a plantation.

The moth attained a peak population in 1948. A study of weather records and population fluctuations of the insect reveals that dry Septembers seem to encourage population increases and wet Septembers inhibits increase.

This study of the zimmerman pine moth clearly indicates that injury to pine plantations can be reduced by maintaining full stocking and encouraging early closure of the stand.

Microfilm $2.00; Xerox $4.20. 76 pages.

THE TRANSVERSE ANISOTROPY OF WOOD AS A FUNCTION OF ANATOMIC STRUCTURE.

(L. C. Card No. Mic 59-4984)

Arno Peter Schniewind, Ph.D.
University of Michigan, 1959

The objectives of this study are to investigate the anisotropy of transverse elastic and shrinkage deformations and maximum tensile strength of wood, by determining the properties and relative proportions of ray tissue, earlywood prosenchyma, and latewood prosenchyma and relating these to the properties of whole wood.

Wood is considered as consisting of alternating layers of earlywood and latewood, which in turn consist of alternating layers of ray tissue and prosenchyma. Whole wood in sizes large enough to incorporate all elements is thus considered as a complex laminate with two successive and perpendicular stages of lamination. On this basis mathematical expressions for the radial and tangential modulus of elasticity, maximum tensile strength, and shrinkage were derived by assuming that the properties of the ray tissue are independent of the location within the growth increment but are anisotropic and that the earlywood prosenchyma and the latewood prosenchyma may or may not differ from each other but are isotropic in the transverse plane.

Part I of the study deals with modulus of elasticity and maximum tensile strength. Radial and tangential modulus of elasticity and maximum tensile strength values were obtained for California black oak (Quercus kelloggii Newb.) at several levels of moisture content. The same properties were determined for the gross anatomic components of the species by means of a micro-tensile test developed for this study. The results were influenced by a size factor of unknown nature but were internally consistent. The ray tissue had by far the highest radial modulus of elasticity and maximum tensile strength of all components. The higher radial modulus of elasticity of California black

oak wood could be fully attributed to the high radial modulus of elasticity of the ray tissue. The rays were also found to be a major factor causing a higher radial maximum tensile strength of whole wood. This could be shown quantitatively only in the green condition, because at moisture contents of 6 and 12 per cent drying stresses of unknown magnitude resulting from unequal shrinkage of the components of wood appeared to influence the results.

Part II of the study deals with shrinkage. Radial and tangential shrinkage measurements were made on whole wood of California black oak. The same properties were determined for the gross anatomic components by measuring the shrinkage of very small microtome sections. The results were very scattered, but clearly showed that the radial shrinkage of the ray tissue is less than the radial shrinkage of the other components. The low radial shrinkage of the rays not only decreases the radial shrinkage of the prosenchyma but also increases its tangential shrinkage because of Poisson's effects. Quantitative evaluation of the effect of gross anatomic structure on differential shrinkage was limited apparently by the occurrence of plastic in addition to elastic strains resulting from unequal shrinkage of the components.

It can be concluded from the results of this study that the transverse anisotropy of the properties of California black oak investigated can be explained on the basis of gross anatomic structure and the difference in property values between the structural components, particularly between the rays and the prosenchyma in the radial direction. Microfilm $2.80; Xerox $9.60. 213 pages.

EFFECTIVE CONSERVATION COMMUNICATIONS: A STUDY OF CONSERVATION INFORMATION-EDUCATION PROBLEMS AND PRACTICES IN AMERICA WITH RECOMMENDATIONS FOR IMPROVING CURRENT METHODS AND MEDIA.

(L. C. Card No. Mic 59-4985)

Joseph James Shomon, Ph.D.
University of Michigan, 1959

Believing that misuse of natural resources constitutes a threat to civilization, and that society would take corrective action if it was fully aware of the situation, conservation communication was studied in four major areas: state government agencies, federal agencies, private conservation agencies, and industry. Research was by personal interview, questionnaire, correspondence, and the examination of communications media, including literature. Extensive travel in the United States and Canada and Alaska was involved.

In Part I of the study, the over-all background and perspective of conservation is examined. Discussed, and to a degree analyzed, are such topics as the challenge of conservation, the problem of resource waste, the slow awakening of conservation, the relationship of human dynamics and conservation, and the theory of communications, including what to communicate and to whom.

Part II is a review and analysis of current conservation communications tools and techniques. Examined in some detail are such media as the newspaper press, conservation magazines, miscellaneous publications and printed matter, motion pictures, radio, television, exhibits and displays, face-to-face communications, and miscellaneous communications. Each medium is examined as to its apparent value, current use, and costs. An evaluation is made of each one and some suggestions for improvement are offered.

Part III covers in theory and practice such administrative matters as organizing the conservation information-education program, cooperation and coordination, and public relations. Some specific suggestions for improvement are made. There is a summary covering each of the three main parts of the dissertation, followed by several conclusions, and a number of broad recommendations. A generous appendix showing case studies and other supporting data follows.

Although a number of general conclusions are drawn from the study, two seem most significant: (1) failure to recognize vital conservation issues and failure to resolve them can lead America to disaster; (2) public awareness in a democracy is the most important single factor in the resolution of our natural resources issues and problems. The communication task at hand is essentially one of informing people rather than merely managing natural resources. Here a clearer understanding of conservation, a healthier resource-use climate, better teamwork, and improved conservation communications can play a helpful role. Microfilm $5.60; Xerox $19.60. 440 pages.

AGRICULTURE, PLANT CULTURE

EFFECT OF EQUAL LETHAL RADIATION AND THERMAL TREATMENTS ON BACTERIAL SPORE GERMINATION.

(L. C. Card No. Mic 59-4126)

Frederick William Billerbeck, Jr., Ph.D.
Purdue University, 1959

Major Professor: Dr. N. W. Desrosier

Some effects of equal lethal gamma irradiation and heat treatments on bacterial spore germination were studied. The pattern of destruction inflicted within the bacterial cell by ionizing radiation and heat differ.

While an exact understanding of the radiation and heat induced alteration within the spore are as yet unknown, it is generally believed that, whatever the mechanism involved, both bring about the same end result. Speculation has centered on molecular inactivation, denaturation of enzymes, denaturation of cytoplasm, disruption of the cell membrane and inactivation of genes. Through this investigation utilizing equal lethal levels of heat and irradiation, certain similarities or dissimilarities of the treatments were determined by their respective physiological response in various metabolites. Further, studies of various radiation attributes such as increased heat sensitivity following radiation, storage characteristics, and germination response of spores receiving different dosage levels were ascertained.

B. coagulans NRS #770, B. subtilis var. niger NRS #365,

and P. A. No. 3679 were selected as representative organisms for purposes of this study.

Several irradiation sources and thermal destruction devices were evaluated to determine respective destruction rates for selected organisms as determined through plating techniques following treatment. Survival curves were plotted, statistically evaluated, and equal lethal levels selected for subsequent studies. Germination studies were conducted with metabolites of the Krebs (Citric Acid) Cycle whose concentrations were equivalent to glucose (0.028M). All metabolic solutions contained a (0.025M) level of K_2HPO_4. Germination responses following incubation in the metabolites at pH 7.0 and 4.7 were determined through heat differentiation (80°C. for 10 minutes). Respective germination responses were determined over a 48 hr. period, and incubation periods were selected for subsequent differentiation studies. Comparative studies of the germination response of untreated and treated spores were conducted at the incubation periods selected for the metabolites.

Critical evaluation of the Purdue Linear Electron Accelerator was made and an incompatible relationship was found between the radiation cell and linear accelerator, resulting in non-uniform ionization which manifested itself in erratic rate of destruction curves. Subsequent radiation utilizing high level gamma irradiation produced an exponential survivor curve for B. subtilis and a curvilinear response for B. coagulans, whose curvature was determined to be significant.

Exponential destruction patterns on heat exposure were found for B. subtilis, B. coagulans, and P. A. No. 3679 with the Purdue Thermosporometer and also with a modified water bath system. B. coagulans in further studies with a Thermal Death Time Retort exhibited significant curvilinear responses at two concentration levels and resulting destruction curves were found to be parallel throughout. Equal lethal treatments were selected from the curves obtained.

Glucose, citric acid, fumaric acid, l-malic acid, and succinic acid exhibited a stimulating influence on B. coagulans spore germination at both pH 7.0 and 4.7. B. subtilis spores at pH 7.0 were capable of utilizing glucose, fumaric acid, and succinic acid, and were only slightly responsive in l-malic acid. Citric acid could not be utilized. Almost complete apparent germination was found at pH 4.7. P. A. No. 3679 was only able to utilize glucose at pH 7.0, and glucose, l-malic acid, and citric acid at pH 4.7. Oxalacetic acid was utilized only at pH 7.0 by B. subtilis and B. coagulans. Only B. subtilis showed slight germination responses upon incubation in isocitric acid, cis-aconitic acid, α-ketoglutaric acid, and pyruvic acid.

A higher overall germination response at pH 4.7 was found and attributed to greater metabolite availability and increased heat sensitivity.

B. coagulans spores yielded significantly different germination responses following equal lethal gamma irradiation and heat treatments at both pH 7.0 and 4.7. Irradiated spores incubated in selected metabolites at pH 7.0 generally possessed and increased germination capacity over controls and were comparable to the controls at pH 4.7. Heat treated spores exhibited reduced germination from that of controls in glucose, and l-malic acid at pH 7.0, and were uniformly less responsive at pH 4.7 than were controls.

B. subtilis irradiated and control spores were not significantly different in their respective responses at either pH level. An accelerated germination response by heat treated over that of the controls was exhibited only in citric acid, l-malic acid, and K_2HPO_4 at pH 7.0.

Enzymatic culpability is discussed.

Applied radiation dose and subsequent germination response of B. coagulans spores were proportionately related, an inverse relationship was found with increasing heat application.

The initial number of B. coagulans spores recovered following irradiation was found to drop off after a week's storage under refrigeration (3°C.) and to increase somewhat in numbers thereafter.

Gamma irradiation induced heat sensitivity in B. coagulans spores, but not in B. subtilis spores.

Further investigation of the physiology of death in bacterial spores is warranted.

Microfilm $2.20; Xerox $7.60. 165 pages.

THE RELATIONSHIP BETWEEN CARBOHYDRATE LEVEL AND ROOT DEVELOPMENT OF TOBACCO TRANSPLANTS AND THE EFFECT OF SOME PLANT BED TREATMENTS ON THESE FACTORS.

(L. C. Card No. Mic 59-4685)

Charles Edgar Dean, Ph.D.
North Carolina State College, 1959

Supervisors: Willie Garland Woltz and
Thurston Jefferson Mann

The objectives of this study were to investigate the relationships between available carbohydrates in tobacco seedlings and root development after transplanting, and to study the effects of some plant bed treatments on these factors.

Reducing the total amount of available carbohydrates in tobacco seedlings by removing leaves before transplanting decreased root development after transplanting. The level of available carbohydrates, estimated as soluble carbon, was highest in the bud leaves and lowest in the larger leaves near the bottom of the plant. Different soluble carbon levels were induced in intact tobacco transplants by placing them in darkness and by the use of a sucrose foliar spray. A positive correlation was found between the level of available carbohydrates, estimated as soluble carbon, and root development after transplanting.

Tobacco transplants hardened by withholding water and by low temperatures continued growth longer in complete darkness than non-hardened plants, and resumed growth more rapidly after transplanting. Hardening induced a higher level of available carbohydrates in the transplants, and root development following transplanting was greater than that exhibited by non-hardened plants. Hardening plants until they wilted was sufficient to produce the maximum soluble carbon level and the maximum root development. Subsequent hardening cycles resulted in a decrease in soluble carbon and root development. In all instances, there was a positive correlation between soluble carbon and root development. Though smaller at transplanting, within three weeks after transplanting

the hardened plants had equalled in size the non-hardened plants.

The rate of growth of tobacco seedlings increased with increased nitrogen levels in the growth medium. Photomicrographs of stem cross sections revealed a larger number of starch grains which were of larger size when the plants were grown on a low level of nitrogen than when grown on a high level of nitrogen. Both available carbohydrate level at transplanting and root development after transplanting were greatest in plants grown on the low level of nitrogen, while the high level of nitrogen produced plants lowest in terms of these factors.

Young tobacco plants seemed unable, for the most part, to utilize nitrogen in the ammonium form. After growing on nitrate nitrogen for forty days, changing to ammonium nitrogen caused a slowing of the seedling growth rate and a darkening of the leaves. The plants had a lower available carbohydrate level at transplanting and a slower root regeneration rate after transplanting than those receiving continuous nitrate nitrogen.

As the spacing between tobacco seedlings in the plant bed was increased, plant size, measured as length x width of the largest transplant leaf, and dry weight increased. The level of available carbohydrates tended to increase as wider spacings were used. Plants grown on a one-inch spacing produced the least amount of new roots after transplanting under both greenhouse and field conditions. Increasing the spacing to two inches between plants increased root development. When the spacing was increased from two to three inches under greenhouse conditions, there was a decrease in new root formation, however, this was explained by the way in which the root systems were trimmed prior to transplanting. Under field conditions, plants produced on a three-inch spacing exceeded those produced on a two-inch spacing in regard to root development. The number of days from transplanting to flowering decreased as wider spacings were used in the plant bed. There was essentially no difference in yield or value per acre of the crop produced by plants from the different spacings. This was attributed to the generally favorable moisture conditions prevailing at the time of transplanting. Transplanting under more adverse conditions may result in differences in plant response.

In all experiments, a positive correlation was found to exist between the level of available carbohydrates, estimated as soluble carbon, in the transplants and root initiation and development after transplanting.

Microfilm $2.00; Xerox $4.60. 90 pages.

COMBINING ABILITY IN TIMOTHY.

(L. C. Card No. Mic 59-4134)

Charanjit Lal Dhawan, Ph.D.
Purdue University, 1959

Major Professor: R. C. Pickett

Progress has been made in developing better methods of forage breeding. The general combining ability as determined by the polycross method or the average of single crosses, has been used in developing new improved synthetic varieties of forage crops. Synthetic varieties have a general decline in yielding ability in the Syn. 2 and later generations. Limited generation hybrids need to be exploited to try to obtain higher yielding, disease-resistant forage hybrids. The present study evaluates the methods of selection and incorporation of desirable timothy plants into synthetics and hybrids.

Six clones of timothy, their S_1's, polycrosses, wide or non-isolated polycrosses, single crosses or mutual pollinations (containing both hybrid and selfed seed), 5-clone synthetics, and a 6-clone synthetic were used in this study. A promising commercial variety, Drummond, was used as the check. General combining ability was studied for the following characters: plant vigor, plant regrowth, leafiness, stem rust resistance, crown width, plant height, and forage yield. Specific combining ability and heterosis for height and yield were studied, in fifteen single crosses. Analysis of variance, "F" test, and the L.S.D. were used for measured data, i.e., crown width, height, and yield. Frequency distributions and the X^2 test were used for the visual data, i.e., vigor, regrowth, leafiness, and stem rust resistance.

Selfed progenies showed a general improvement over the clones for all characters except stem rust resistance. The S_1 progenies were more rust susceptible than the clones. Plant yield showed the greatest improvement for all clones. The biggest increase was the doubling of yield of the S_1 of clone 15.

The polycross progeny gave the best estimate of general combining ability for plant vigor and regrowth. The S_1 progenies of clones 12, 16, and 18 gave a good prediction of the general combining ability of these clones. The polycross progeny was recommended for determining the general combining ability of these characters.

Both the polycross and the S_1 progenies were found to be efficient in predicting general combining ability for leafiness and stem rust resistance.

Significant differences occurred among clones, for crown width, height, and yield. These differences were presumed to be genetic and the polycross progenies gave the best estimate of general combining ability for these characters.

No significant differences were observed between the 6-clone synthetic and 5-clone synthetics. The inclusion or exclusion of any one of these six clones did not significantly affect the performance of the synthetic. The 6-clone synthetic did not significantly differ from the check variety, Drummond.

Specific combining ability was estimated by subtracting the general combining ability value (determined by the polycross test) from the single cross value (which includes deviations due to general combining ability, specific combining ability, and environment). Six single crosses for height and four single crosses for yield showed significantly positive specific combining ability. The clones that produced these single crosses also showed high general combining ability for height and yield. Some of these single crosses showed a high degree of hybrid vigor. These single crosses yielded 50-170% more than the parents and up to 45% more than the check variety.

The mutual pollinations, or "F_1" hybrids, containing some selfed seed, have shown good performances and give hope for the use of limited generation hybrids on a commercial scale. Once the desirable parental plants have been selected, it should not be difficult to produce and maintain these hybrids. The role of inbreeding in

direct improvement also showed promise in these timothy lines.

Microfilm $2.00; Xerox $5.20. 103 pages.

FACTORS FOR RESISTANCE TO PRE-EMERGENCE DAMPING-OFF IN PEA (PISUM SATIVUM L.) INCITED BY PYTHIUM ULTIMUM TROW.

(L. C. Card No. Mic 59-5304)

Elmer Ellis Ewing, Ph.D.
Cornell University, 1959

Several varieties of peas were found to be resistant to pre-emergence damping-off when planted in steamed soils which had been inoculated with Pythium ultimum or when planted in the field near Toluca, Mexico. The causal organism chiefly responsible for the disease in the field appeared to be Pythium ultimum. The resistant varieties fell into a single group; but of the non-resistant varieties studied, some were much more susceptible than others.

Resistance was shown to be due to the presence in the testa of the basic (fundamental) gene A for anthocyanin. Insofar as resistance to pre-emergence damping-off was concerned, this gene worked solely through the testa. Whether or not it was present in the embryo did not affect resistance. Seeds which were enclosed in A testas were resistant regardless of whether cotyledons were round (R) or wrinkled (r), and of whether they were yellow (I) or green (i).

If seed coats were a, then the degree of susceptibility was greatly influenced by the status of the R-r gene pair. Wrinkled (r) seeds were much more susceptible than round (R) seeds borne in the same pods. No exceptions were found to this rule although the degree of superiority of round over wrinkled was dependent upon the pedigree. The susceptibility of seeds with a testas was also affected by the condition of the I-i gene pair. Yellow (I) seeds gave better stands than did green (i) seeds borne in the same pods.

Genetic evidence from the effects on resistance of three gene pairs (A-a, B-b, and a third pair thought to be Mp-mp) showed that resistance was intimately associated with the presence in the testa of tannin-like, colorless, phenolic compounds. There are indications that these tannin-like compounds belong to the general category known as leucoanthocyanins, and that compounds of delphinidin are involved. The probable cause of the horticulturally undesirable darkening upon cooking and astringent taste of A seed coats is the same type of phenolic compound which is genetically associated with resistance to pre-emergence damping-off, making it appear unlikely that resistance can be separated from these undesirable effects.

It was not determined whether the association between the presence of the leucoanthocyanin-like compounds and resistance is due to a direct, fungistatic relationship; to other chemical effects on the fungus; or to some indirect relationship between the presence of these compounds and the structure of the testa.

Microfilm $2.00; Xerox $6.00. 125 pages.

THE EFFECT OF CATHODE RAYS ON FOOD SPOILAGE FUNGI.

(L. C. Card No. Mic 59-4139)

Marion Lee Fields, Ph.D.
Purdue University, 1959

Major Professor: Gale R. Ammerman

One of the problems in processing foods by ionizing radiations is the killing of fungal spores and mycelia and inactivation of enzymes of both the food and the organism. Various investigators have found that irradiated foods are more susceptible to the breakdown by enzymes than non-irradiated foods and that irradiated foods may be more susceptible to food spoilage microorganisms. Also of interest are the fundamental problems of comparative resistance of different fungi to irradiation, the rate of reaction of fungal enzymes on irradiated substrates, the chemical nature of the irradiated substrates, the nutrition of food spoilage fungi when grown on irradiated substrates, and the inactivation of selected enzymes of a food spoilage fungus in vivo and in vitro.

High levels of cathode rays were required to reduce the activity of alpha amylase and the sucrase of the test organism Aspergillus oryzae (Ahlbury) Cohn ATCC strain 11601. Inactivation of the amylase in the cell appeared to be associated with growth inhibition of the fungus, while sucrase activity was found at much higher doses than that required to inactivate the fungus.

Aspergillus flavus Link NRRL strain 485 and Aspergillus tamarii Kita NRRL strain 427 were found to be significantly different in resistance to irradiation as determined by the plate count method and the spore germination method.

The shapes of the death curves of A. oryzae and a species of Fusarium were determined by using 3.0 MeV cathode rays. The death curve observed for A. oryzae was exponential in nature, while that for the multicellular-spored fungus Fusarium sp. was sigmoidal. Sagging death curves were observed for Aspergillus niger van Tieghem ATCC strain 10864, A. tamarii, A. flavus, and A. oryzae when they were bombarded with higher energy cathode rays (4.5 MeV).

The growth of A. oryzae (non-irradiated) was measured by weighing the dried fungal mat after growth in media to which had been added the following irradiated nutritive substances: sucrose (in Czapek-Dox broth in the dry and liquid forms), gelatin, glucose, glucose-asparagine, and starch. These media were irradiated in the range used in the processing of foods.

Growth was inhibited significantly on irradiated liquid Czapek-Dox broth, but the growth of A. oryzae was stimulated when the medium was irradiated in the dry form. There was no difference in spore germination in the liquid, irradiated Czapek-Dox broth and the non-irradiated medium. There was no inhibition of the sucrase of A. oryzae when reacted with the media which had been irradiated at a high dose. The inhibition of A. oryzae apparently was due to the inability of the fungus to metabolize either the sucrose or other parts of the medium.

Significantly, different growth responses were measured on the irradiated glucose-asparagine, glucose, and starch media. There was no difference in growth on irradiated gelatin when compared to a non-irradiated control.

Color changes occurred in the irradiated Czapek-Dox broth and the glucose-asparagine medium. The color changes were followed spectrophotometrically at 400 millimicrons. Changes in pH, titratable acidity and reducing sugars were also detected in the Czapek-Dox broth.

Increased reducing power was noted in starch and dextrin when irradiated.

Enzymes of the test organism were reacted with the irradiated substrates sucrose and starch, and the substrates were found to be more accessible to the enzymes.

Microfilm $2.30; Xerox $8.20. 176 pages.

EFFECTS OF PLOIDY DIFFERENCES ON HORTICULTURAL CHARACTERISTICS AND DISEASE RESISTANCE IN WATERMELONS.

(L. C. Card No. Mic 59-4144)

Charles Herbert Green, Ph.D.
Purdue University, 1959

Major Professor: E. C. Stevenson

Tetraploids of the watermelon varieties Klondike R-7, Purdue Hawkesbury, Early Bird, and Early Canada were hybridized with diploids to produce triploids. Plant and fruit characteristics and Fusarium wilt resistance were studied for diploids, triploids, and tetraploids. The research was designed to provide information on the effect of ploidy on horticultural characteristics and disease resistance.

Characteristics observed were pollen size, leaf size, staminate flower size, fruit shape, fruit weight, rind color, rind thickness, rind toughness, hollow heart, percentage of soluble solids of the flesh, and seed coat size.

The tetraploids had larger pollen grains and larger staminate flowers and leaves than their diploid parents. Triploids were intermediate between the tetraploids and diploids for these characteristics.

Fruit shape varied with the degree of ploidy. Diploid varieties having ellipsoidal fruits produced round tetraploids. When the plants with round tetraploid fruit were hybridized with diploid plants with ellipsoidal fruits the fruit shape of the progeny was intermediate between the two parents. Tetraploid plants with round fruits hybridized with diploid plants with round fruits produced round fruited progenies.

Tetraploid fruit weights were less than diploid weights for watermelons derived from ellipsoidal diploids.

The soluble solids content of diploids, triploids, and tetraploids from the same variety were not different. Some of the triploid and tetraploid fruits had a strong taste considered undesirable. This "polyploid flavor" was more pronounced in tetraploids than triploids. It was stronger in immature and overripe fruits. Polyploid flavor never was present in the diploid fruits.

In crosses involving plants with light green rind and dark green rind, the color of the progeny was always dark green whether dark green was used as the tetraploid or diploid parent.

The amount of hollow heart, the rind thickness, and the seed coat size of triploids depended on the particular parents used. Certain combinations produced triploids with hollow heart, thick rinds, irregular fruits, and large seed coats.

In breeding for desirable commercial triploid (seedless) watermelons, it was not possible to predict the desirability of the triploid based on the performance of the parents. Even though the parents used were acceptable commercial varieties, when they were crossed to produce triploid melons none of the triploids produced in the experiment were acceptable commercially. The development of triploid varieties would appear to be empirical.

Better triploids were produced by crossing two diverse parents rather than by crossing closely related parents. For example, the triploid F_1 (Early Canada 4n X Klondike R-7 2n) gave better fruits than the triploid F_1 (Klondike R-7 4n X Klondike R-7 2n).

Tetraploid and triploid Purdue Hawkesbury produced only cull fruits.

A method was developed and tested for screening watermelon seedlings in the greenhouse for resistance to the Fusarium wilt disease. A comparison of tetraploid and triploid Klondike R-7 with resistant diploid Klondike R-7 revealed no increase in the Fusarium wilt resistance of the polyploids.

Microfilm $2.00; Xerox $5.80. 118 pages.

THE GROWTH-PROMOTING AND INHIBITING SUBSTANCES IN RESTING PEACH FLOWER BUDS.

(L. C. Card No. Mic 59-4688)

Charles Henry Hendershott, Jr., Ph.D.
North Carolina State College, 1959

Supervisor: David Rudger Walker

A study was made to determine the effect of age of seedling, length of coleoptile, location of coleoptile section on the seedling, pH, sucrose and incubation period on the growth of etiolated wheat coleoptile sections. It was found that the best procedure to use when conducting the wheat straight-growth bioassay was as follows:

1. Use seedlings 25-35 mm long.
2. Remove the first 3 mm from the tip of the coleoptile.
3. Use a 4 mm section for testing.
4. Place the coleoptile sections in a phosphate-citrate buffer at pH 5.0.
5. Use a 2 percent (w/v) sucrose solution.
6. Incubate the seedlings for 20 hours before measuring.

A study of the growth-promoting and growth-inhibiting substances present in dormant peach flower buds during the rest period revealed three growth-promoting substances and one inhibiting substance. The promoters occurred at Rf 0.15, 0.36 and 0.89 in n-butanol-ammonia, but did not develop color with indole reagents such as Gordon-Weber's and Salkowski's. They were present in biologically significant amounts, but not statistically significant quantities. The greatest quantity of these

substances occurred in the buds during the months of January, February, and in early March. These substances chromatographed in the same position as IPyA (Rf 0.15), IAA (Rf 0.36), and EtIA or IAN (Rf 0.89).

A growth inhibitor was detected on the chromatograms at an average Rf of 0.56. This substance was present in high concentrations in the peach buds in August, then decreased to a very low concentration in October. The inhibitor again increased in concentration in November and remained rather high during the months of December, January, and February. It decreased in concentration during the month of March and completely disappeared from the buds about two weeks before bloom. A close correlation was observed between the growth of buds on excised twigs (end of rest) and the disappearance of the inhibitor.

All evidence obtained strongly suggests that the growth-inhibiting substance was naringenin (5, 7, 4' trihydroxyflavanone). This evidence was based on comparison of the unknown with authentic naringenin in infrared, ultraviolet spectra, chromatography, color tests, activity in the bioassay test, and melting point determinations.

Microfilm $2.20; Xerox $7.60. 165 pages.

THE REACTION OF CYANIDE IN SOILS AND ITS EFFECT ON THE GROWTH AND ION UPTAKE OF CORN.

(L. C. Card No. Mic 59-4689)

Arvel Hatch Hunter, Ph.D.
North Carolina State College, 1959

Supervisor: Nathaniel Terry Coleman

Methods for the extraction of cyanide from soils and for the determination of free and complexed cyanide in soil extracts were developed. In addition, an ion exchange method for the separation of Al, Mn, Co, Cu, Fe, Mo, and Zn in plant material was devised, and was combined with spectrophotometric analysis to give a rapid and precise means for measuring plant contents of the elements in question. The two methods were used in studying cyanide reactions in soil and in determining the effect of cyanide additions to sand cultures and soils on the mineral nutrition of corn.

In determining total or complexed cyanide in soil extracts, distillation with tartaric acid was found to be suitable. Such a procedure separates cyanide from substances, including complexed metal ions, which interfere with its colorimetric or titrimetric measurement. The use of tartaric acid, rather than other distilling reagents which have been suggested, prevents the spuriously high "recoveries" of cyanide which were observed when the soil extract contained nitrate. The distilling apparatus which was designed and constructed prevents the loss of free cyanide during the addition of reagents or during distillation itself. Using the method and the apparatus devised, excellent recoveries of cyanide from soil extracts and solutions containing complex cyanide were obtained.

The determination of the metal ions was accomplished by wet ashing the plant material and subsequently separating the ions by an anion exchange process. The variable stabilities of the metal complexes formed in different concentrations of hydrochloric acid allowed for clear-cut separation of all of the metals except iron and molybdenum. These two ions can be easily determined colorimetrically in the presence of each other. After separation, standard colorimetric procedures could be used for the determination of the metals. An aliquot from the same ashed sample also was analysed for Ca, K, Mg, and P. The analytical procedure is relatively simple, rapid and economical, and requires only a small quantity of plant material. The error of determination ranged from about two to seven per cent.

To study the fate of cyanide in soils, the amounts of free and complexed cyanide remaining in the solution phase of soil-KCN mixtures were measured after different contact times. With dilute cyanide solutions, equilibrium was established in about twenty-four hours. The amounts of cyanide removed from solution by four soils were in the order: Portsmouth >> Cecil > Madison > Lakeland. The cyanide remaining in solution was present both as free ionic cyanide and as complexed cyanide. The amount of soluble complexed cyanide approached a maximum with the addition of about 0.625 grams of cyanide per 100 grams of soil. The solution in equilibrium with the Portsmouth soil contained a little more than twice as much complexed cyanide as that from the Cecil and Madison soils, and about three times as much as that from the Lakeland soil.

The cyanide contents of soils were increased during the decomposition of cyanogenetic plants, indicating that in nature, this may be a substantial source for the accumulation of cyanides in soil.

The effects of substrate cyanide on plants were influenced by the nature of the substrate. Corn plants in sand culture died with the addition of about 15 ppm cyanide. Death of the corn plants in the Lakeland soil occurred with the addition of 320 ppm cyanide and in the Madison, Cecil and Portsmouth soils with 1280 ppm cyanide.

Cyanide in sand culture, in amounts less than that necessary to produce necrosis, resulted in changes in the P, K, Ca, Mn, Fe, and Zn contents of the corn plants. Except for potassium content the roots and tops were affected differently.

Cyanide added to soils resulted in changes in the K, Ca, Mg, Al, Mn, and Zn contents of the corn plants grown. Except for potassium and zinc, the effect varied, depending on the soil type.

Microfilm $2.00; Xerox $5.80. 116 pages.

THE INHERITANCE OF COLD RESISTANCE AND ITS RELATION TO FALL GROWTH IN F_2 AND BC_1 GENERATIONS OF ALFALFA.

(L. C. Card No. Mic 59-4158)

Russell James Kohel, Ph.D.
Purdue University, 1959

Major Professor: R. L. Davis

An investigation was initiated to study inheritance of cold resistance and fall growth and their association.

Material evaluated in this study consisted of three parental clones, selected F_1 plants, and their F_2 and BC_1

progenies. The three parents consisted of a selection from Canadian Variegated which had dormant fall growth and cold resistance, a selection from African which was cold susceptible and had non-dormant fall growth, and a selection from Du Puits which was intermediate for both characters.

Fall growth was evaluated in the field and in a controlled greenhouse environment. Cold resistance was measured by determining the specific conductivity of exosmosites from frozen root tissue, and winter survival was measured as percent survival.

Under the greenhouse environment, there was no measurable genetic variation associated with fall growth. Under the field environment, 17% of the total within-variation was attributed to the additive genetic variation of fall growth when measured as plant height. The data also suggested dominant gene action conditioning non-dormant fall growth.

Night temperatures of 36° F. for 16 hours and day temperatures of 65° F. with natural sunlight for 2 weeks followed by freezing uniform root samples at -5° C. was satisfactory in evaluating differences in cold resistance expressed by 2-month-old alfalfa cuttings.

Selected F_2 and BC_1 plants were evaluated for cold resistance. Results for F_2 selections were variable, but refined technique provided a more accurate estimate of cold resistance for BC_1 selections. The values obtained for selected BC_1 plants suggested cold susceptibility was controlled by incompletely dominant gene action.

The winter survival of BC_1 lines was significantly correlated to the measured cold resistance. Due to the variability of the cold resistance test, F_2 cold resistance and winter survival were not significantly correlated but followed the same trend as the BC_1 lines.

Selected plants did not show any significant association between fall growth and cold resistance. However, mean fall growth and mean winter survival for F_2 and BC_1 lines were significantly correlated indicating survival was associated with dormant fall growth. This was also suggested by the significant correlation of fall growth and specific conductance.

Approximately 25% of the variation in fall growth was due to its linear association with cold resistance. If dormant fall growth and cold resistance are conditioned by the same genetic factors, this low degree of association can be due to variability of the fall growth test, but, if these characters are conditioned by separate genetic factors, the low degree of association can be attributed to recombination of these factors.

Microfilm $2.00; Xerox $3.80. 70 pages.

EFFECT OF PHOSPHATE PLACEMENT AND SOIL TEMPERATURE ON PHOSPHORUS ABSORPTION AND GROWTH OF TOMATOES.

(L. C. Card No. Mic 59-4162)

Salvadore Joseph Locascio, Ph.D.
Purdue University, 1959

Major Professor: G. F. Warren

Observations of field-seeded tomatoes indicate that purpling, characteristic of phosphorus deficiency, often occurs and that the seedlings grow at a reduced rate although fertilizer has been banded a few inches from the seeds. To determine the best placement of phosphorus fertilizer, a greenhouse experiment was designed to determine the growth pattern of tomato roots by specific placements of radio-active phosphorus and by washing out and observing the root system. The initial root growth was of the taproot type, penetrating about an inch by the time the cotyledons emerged (9.5 days after seeding). After this relatively shallow penetration, root growth was as rapid laterally as vertically. For absorption of phosphorus to occur from placements 1 inch to the side and 2.5 inches below the seed, and 2 inches to the side and 2.5 inches below the seed, from 28 to 31 days were required.

Various methods were investigated to increase the phosphorus concentration in the root zone. Greenhouse studies showed the high efficiency of applying mono-potassium or mono-ammonium phosphates directly on the tomato seeds. The equivalent of 5 pounds of phosphorus per acre applied on the seeds resulted in growth and phosphorus uptake comparable to that obtained with 285 pounds of phosphorus per acre mixed with the soil.

Placement of 30 pounds of phosphorus per acre 1.5 inches below the seed was far superior in increasing growth and phosphorus uptake compared to placing the same amount 1.5 inches to the side and 1 inch under the seed, or 3 inches to the side and 2.5 inches under the seed. However, when a seed application was made in addition to these placements, comparable growth resulted. In field studies, near maximum yields of tomatoes were produced regardless of the placement of the band fertilizer when a seed application was used.

The effects of soil temperature and phosphorus level on growth were studied with controlled conditions in the greenhouse. Growth and phosphorus absorption were much less at a soil temperature of 55 degrees than at 70 or 85 degrees F. No significant difference existed between growth and phosphorus uptake at 70 and 85 degrees F. However, the relative response to phosphorus was much greater at the low temperature than at the two higher temperatures. Growth increased linearly with increased rates of phosphorus at a soil temperature of 55 degrees F. At the two higher soil temperatures growth reached near maximum with the first increment of phosphorus.

Due to the relatively slow root growth of tomatoes, and to the cool temperatures prevailing at field planting time, close placement of phosphorus fertilizer is imperative to produce maximum growth and yield.

Microfilm $2.00; Xerox $5.00. 97 pages.

THE EFFECT OF CERTAIN SOIL AND SHADE CONDITIONS UPON SEEDLING GROWTH AND NODULATION IN BIRDSFOOT TREFOIL, LOTUS CORNICULATUS L.

(L. C. Card No. Mic 59-5118)

Guy William McKee, Ph.D.
The Pennsylvania State University, 1959

Birdsfoot trefoil, Lotus corniculatus L., a promising forage legume, is often slow to become established and stand failures are common. Lack of nodulation or

inadequate nodulation, at times, may contribute to the establishment problem.

Field and greenhouse experiments were conducted to secure information on some of the seedling growth and nodulation responses of birdsfoot trefoil subjected to several conditions of shading, daylength, competition, soil moisture, and soil fertility. Observations were also made on the relative survival and nodulation of red clover, alfalfa, and birdsfoot trefoil under several conditions of soil acidity and soil fertility on the Jordan Soil Fertility Plots.

Seedling growth and nodulation in Pennscott red clover, Vernal alfalfa, and birdsfoot trefoil, from 12 different seed sources, was evaluated under 6 intensities of shading ranging from 100 to 1 percent of full daylight.

Under light intensities of 50 to 25 percent of full daylight seedling growth and nodulation in birdsfoot trefoil was affected proportionately more than that of either Vernal alfalfa or of Pennscott red clover. At light intensities of 25 percent or less of full daylight the seedling growth and nodulation responses of birdsfoot trefoil were comparable to those of Vernal alfalfa and of Pennscott red clover.

At light intensities of 25 percent of full daylight or less the leaf area of Vernal alfalfa and of Empire and Viking birdsfoot trefoil was comparable. At light intensities greater than 25 percent of full daylight the leaf area of Pennscott red clover increased with shading, the leaf area of Vernal alfalfa remained nearly constant, but the leaf area of birdsfoot trefoil declined one-third to one-half.

Slight to moderate shading depressed nodulation in birdsfoot trefoil correspondingly more than in alfalfa or red clover. Light intensities of 50 percent or greater of full daylight were required for seedling growth and nodulation in birdsfoot trefoil comparable to that of alfalfa and red clover at 25 percent of full daylight. Top and root growth were highly correlated with solar and sky radiation, but nodulation and top or root weight and nodulation and solar and sky radiations were correlated to a lesser degree or the correlation was not significant.

Top and root growth, leaf area, and nodulation of birdsfoot trefoil grown in association with S-37 orchardgrass, Clinton 59 oats, and red root pigweed, each at several populations, was reduced proportionately more than the corresponding top and root growth, leaf area, and nodulation of Vernal alfalfa or Pennscott red clover.

Birdsfoot trefoil responds to well-limed fertile soils, but proportionately less than seedlings of alfalfa or of red clover. Nodulation in Viking and Empire birdsfoot trefoil occurred over a pH range of 4.4 to 7.9 with the best nodulation at pH 6.2 to 6.9.

Inadequate nodulation or inhibition of nodulation was more common in birdsfoot trefoil than in Vernal alfalfa or Pennscott red clover, and is associated with the relative shade intolerance of birdsfoot trefoil and its failure to respond to liming, soil fertilization, and soil mixture to as great a degree as does the associated species. Birdsfoot trefoil root nodule bacteria survived only one week of dessication in an acid (pH 5.0) infertile soil, but survived 6 weeks of dessication in the same soil limed to a pH of 6.5 and fertilized.

Birdsfoot trefoil seedlings from seven different seed sources were exposed to six different photoperiods. Daylength affected both top and root growth, plant form, plant color, and nodulation. Best nodulation, top, and root growth occurred under conditions of a 13 to 14.5 hour photoperiod.

Microfilm $3.90; Xerox $13.20. 303 pages.

A STUDY OF QUANTITATIVE INHERITANCE OF HEIGHT AND OF YIELD IN MEDICAGO SATIVA L.

(L. C. Card No. Mic 59-4174)

Eugene Pergament, Ph.D.
Purdue University, 1959

Major Professor: R. L. Davis

A study of the differences in plant height and yield of two plant selections of M. sativa L. and their progenies was made. Parent 7 grew to final heights ranging from 200 to 225 cm. in the greenhouse. Parent 4856 grew to final heights ranging from 100 to 125 cm. in the greenhouse. The morphological, anatomical, physiological and genetical bases for the differences in height and yield were studied.

The effects of temperature (constant vs. alternate), photoperiod (12 and 20 hours) and light intensity (750, 1500, and 3000 foot candles) on the height of the two parents were studied in an illumination chamber. Three separate measurements were inconclusive because of the small number of replications and short period of growth (18 days).

The effects of temperature (15.6°, 21.1° and 26.7° C.), photoperiod (8 and 16 hours) and period of measurement (30 day intervals for 180 days) on the height of the two parents were studied in the controlled climate chambers. Within each environmental condition, the height of parent 7 was significantly taller than the height of parent 4856, except for the 30 day means.

Differences between the parents in plant height were attributed to the number of cells per unit area and not to the length of cells per unit area. Differences in plant diameter were attributed to cell width per unit area and not to an increase in the number of cells per unit area.

The difference in auxin concentration of the two parents was not significant.

The estimates of genotypic variance of mature height in the greenhouse, based on variance components from the analyses of variance of the S_1 and F_1 generations, were consistent and ranged from 75.2 to 85.9 per cent. During 1957, the estimates of genotypic variance of height in the field were consistent and ranged from 31.4 to 56.4 per cent. In 1958, the estimates of genotypic variance of mature height and yield were 90.0 and 70.4 per cent, respectively.

For the regression of F_2 seedlings on F_1 seedlings, the estimates of genotypic variance of height in the greenhouse ranged from 0.0 to 17.3 per cent. For the regression of F_2 seedlings on F_1 clones, the estimates ranged from 1.2 to 32.4 per cent. Estimates of genotypic variance of height in the field were consistent within and between years, ranging from 42.0 to 56.0 per cent. The estimate of genotypic variance of yield was 21.1 per cent.

The estimates of genotypic variance of height in the greenhouse, based on the variances of F_2 families, were predominately negative. In 1957, the mean estimates of

genotypic variance of height in the field ranged from 16.6 to 81.0 per cent. The mean estimates of genotypic variance of mature height in the field were 47.9 and 61.8 per cent in 1957 and 1958, respectively. The estimate of genotypic variance of yield was 26.2 per cent.

Differences in the estimates of genotypic variance due to the method of analysis were attributed to: (1) type of generation analyzed; (2) interaction effects; and (3) estimation of environmental variances.

A mathematical model was formulated to determine the contribution of each gene locus to the additive and non-additive components of the genotypic variance observed in an autotetraploid population. By extending the mathematical model, formulas were derived for partitioning the total variation of the F_1 and F_2 generations.

The partitioning of the components of variation of mature height in the greenhouse and in the field, 1957 and 1958, was similar. The genetic contribution to the variation in the F_1 and F_2 generations was primarily due to additive gene action.

The genetic contribution to variation in plant yield was mainly due to non-additive gene action.

The effects of multiple allelism, quadrivalent formation at meiosis, linkage, non-allelic interactions and experimental design were discussed in regard to the interpretation of results based on the mathematical model.

The estimates of the minimum number of effective genetic factors differentiating the mature height of the two parents ranged from 0.29 in the field to 1.32 in the greenhouse. The two estimates of the minimum number of effective genetic factors conditioning the expression of yield were 8.28 and 11.72.

Microfilm $2.00; Xerox $5.60. 115 pages.

SOME REACTIONS OF ALUMINUM IN ACID SOILS AND THEIR IMPLICATIONS CONCERNING ROOT GROWTH

(L. C. Card No. Mic 59-4693)

John Leonard Ragland, Ph.D.
North Carolina State College, 1959

Supervisor: Nathaniel Terry Coleman

Greenhouse experiments, using barley, grain sorghum and sweet corn, showed that the growth of roots is inhibited, sometimes severely, in acid soil layers. Roots grew poorly, if at all, in most subsoils unless lime was added. It was concluded that the primary benefit of lime was its effect on converting toxic Al-ions to $Al(OH)_3$. The addition of fertilizers, without lime, reduced root growth, presumably due to an increase in soil-solution Al caused by the displacement of electrostatically-bonded Al by the cations of the fertilizer salts. Only the Al in solution was found to be toxic. The minimum solution concentration of Al which severely inhibited root growth varied with the plant species and with other experimental conditions, but was on the order of one ppm Al.

In investigating the relationships between the pH's and the Al concentrations of soil solutions or soil-electrolyte mixtures, it was found that the observed concentrations of H-ions could be accounted for as resulting from the hydrolysis of Al. For subsoils with pH values (measured in 0.01M $CaCl_2$) of less than about 4.8, a practical hydrolysis constant (pK_h) of 4.6 was found to describe fairly well the relationship of pH to pAl in supernatant liquids from 1:5 soil-0.01M $CaCl_2$ mixtures. Changing either the soil-to-solution ratio or the concentration of $CaCl_2$ resulted in a different value for the hydrolysis constant. The possibility of using these "practical" hydrolysis constants for predicting Al concentrations in soil solutions from simple pH measurements was discussed, and was judged to be real.

In attempting to generalize the relation between the quantities of exchangeable Al present in soils and Al concentrations in soil solutions, adsorption isotherms, using the Al-Ca ion pair, were constructed for Utah bentonite and White Store soil. The Al-ion was strongly preferred over greater than 90 per cent of the range of solution equivalent fractions. Isotherms for the two adsorbents were practically identical, thus indicating the greater importance of the ion-pair than the adsorbent in determining exchange equilibria. Calcium-Al exchange equilibria in certain Coastal Plain soils were similar to those measured for the Utah bentonite and White Store soil.

The hydrolysis of soil-solution Al in continuously wet systems proceeded in a characteristic manner for different soils, being much more extensive with the Creedmoor than with the Cecil. The alternate wetting and drying of acid soil-$CaCl_2$ mixtures at 80°C resulted in rapid, almost complete, "loss" of both solution-phase and exchangeable Al from White Store soil and Utah bentonite. No such loss occurred with the Cecil soil. An equivalent amount of Cl disappeared where Al was "lost." The reactions responsible for Cl and Al "disappearance" were volatilization of HCl and hydrolysis of Al to aluminum oxide or hydroxide. For each solution Al "lost" Ca exchanged another Al-ion into solution, so that after a few days of treatment the soil was practically Ca-saturated. The HCl was the product of H-ions produced by hydrolysis of Al-ions and the Cl was added to the system as $CaCl_2$. Because the Cecil soil adsorbs Cl, HCl did not volatilize in significant amounts from mixtures containing this soil.

Microfilm $2.00; Xerox $7.00. 150 pages.

BIOASSAY OF ANTERIOR PITUITARY HORMONES OF THE RAT AFTER SEVERE STRESS.

(L. C. Card No. Mic 59-4750)

Richard F. Timmer, Ph.D.
The University of Texas, 1959

Supervisors: Dr. Donald Duncan
Dr. Edward G. Rennels

The effects of severe stress, scalding in water at 70°C. for five seconds while under nembutal anesthesia, were studied on the male albino rat to determine the responses of the anterior pituitary gland. A study was made of the weight of the anterior pituitary of large numbers of control animals and animals killed at time intervals of one, three, twelve, and twenty-four hours after stress. There were 72 control animals and 72 test animals in each group sacrificed at a given time. It was found that glands of control animals weighed 3.59 mg. and that there was a statistically significant decrease in wet weight at three hours (3.29 mg.) and at twelve hours (3.25 mg.) after stress. These facts are also borne out when the anterior pituitary weight is expressed in relation to body weight.

Using hypophysectomized rats, bioassays utilizing numerous criteria for several hormones were performed on the anterior pituitaries of each of the stressed groups to determine their hormone content per one and two milligrams of dry powder. Assay procedures for growth hormone using the tibial epiphyseal cartilage response gave results which indicated a significant decrease in content of the glands of the twelve hour (254 μ) post-stress group as compared to controls (293 μ). Utilizing an increase in the height of the thyroid follicular epithelium of the assay animals as an index of thyrotrophic hormone activity, it was found that the hormone content in the twelve hour post-stress animals was significantly increased (10.0 μ) as compared to controls (8.0 μ). Bioassay for gonadotrophic hormones indicated no changes in the hormone content of the anterior pituitary at any time following stress as measured by increase in weight of the ovaries or uteri of assay animals.

The adrenocorticotrophic hormone contained in the anterior pituitary was determined for control animals and for animals subjected to scalding and killed at the following intervals after stress: immediately after stress, fifteen and thirty minutes, and one, three, twelve and twenty-four hours. Adrenal ascorbic acid assays for ACTH performed in hypophysectomized rats indicated a control value of 18.8 milliunits per milligram of wet anterior pituitary tissue. A brief increase in ACTH content to 26.0 milliunits at 30 minutes post-stress is followed by a rapid decrease beginning at one hour (13.8 m. units) after stress and becoming most pronounced at twenty-four hours (9.8 m. units).

The decrease in content of ACTH and growth hormone of the anterior pituitary of post-stress animals is interpreted as a factor to explain the loss in weight of the gland in these animals. Other factors discussed which might account for this increase in weight are electrolyte shifts, cellular protein imbalance, and dehydration specific to burn stress.

In further experiments animals possessing stilbestrol-induced tumors of the anterior pituitary were subjected to the same scalding procedure. Twelve hours after severe burn stress the tumorous pituitaries of these animals weighed 6.44 mg., which was slightly greater than that found for the glands of the non-stressed stilbestrol treated animals (6.01 mg.). Investigators have found these tumors to contain mostly orange acidophils and chromophobes with few basophils present. This cellular picture has been correlated with a high prolactin content and a deficiency in other pituitary hormones. Thus a failure to find a decrease in weight of these pituitary tumors following the stress of scalding might be due to a deficiency of cells producing growth hormone and ACTH both of which were found to be decreased in normal animals subjected to scalding.

When the effects of various stressors, such as swimming, hemorrhages, cold and electric shock were studied in regard to weight of the anterior pituitary none of these groups displayed a decrease in weight of the anterior pituitary similar to that seen at twelve hours after scalding. From this observation it was concluded that this loss in weight of the anterior pituitary may be peculiar to burn stress and related to its severity and continuing nature.

Microfilm $2.00; Xerox $4.80. 94 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

THE ORIGIN OF THE OSAGE INDIAN TRIBE: AN ETHNOGRAPHICAL, HISTORICAL AND ARCHAEOLOGICAL STUDY.

(L. C. Card No. Mic 59-4894)

Carl Haley Chapman, Ph.D.
University of Michigan, 1959

The purpose of the study is to investigate the origin of the Osage Indian tribe. The problem of tribal origin involves a definition of the concept of tribe as it applies to a specific group, in this instance the Osage. The origin problem includes a combination of cultural, historical and environmental factors, among them the contacts of the group with Europeans as well as with other Indians.

In order to ascertain the derivation of the tribal unit it is necessary to trace the Osage tribe as a whole or by its various parts into the past. The terminal date of the study is 1872 A.D. when the Osage were definitely a tribe in any sense of the word. The time interval is the preceding 200 years, starting in 1673 A.D.

The first step in the study is to define the Osage tribe by compiling an ethnographic description of it. The second is to construct a historical chronology of the tribe or the units eventually making up the tribe. The geographical occurrence of each unit is emphasized in the gathering of the data. The third step is to determine the archaeological assemblage associated with the entity considered to be Osage as it is derived from research on historically documented Osage camp and burial sites. Fourth, using the compilations in ethnography, history and archaeology as a reservoir of information for reference, the origin problem is investigated.

Seven lines of evidence bearing on the problem of Osage origin are explored. These are: (1) mythology, (2) legend, (3) history, (4) language, (5) ethnography, (6) animal and plant distributions and (7) archaeology. The general information supplied by mythology is not very valuable to the study, and legend is found to be untrustworthy in regard to names, places and events. Historical information is definitive in the location of Osage campsites and hunting territories for a two hundred year period. Linguistics establish the position of the Osage dialect in relation to the Dhegiha division and to the Siousan language grouping. The ethnographic sketch of the Osage aids in relating the ethnographical unit or entity to neighbors in the Southern Prairie cultural subarea. Plants and animals figuring prominently in myth, legend or used as clan names are found predominantly to have been those native to the known range of the Osage in historic times. Archaeological evidence favors the derivation of the Osage assemblage from late prehistoric Mississippi complexes in the general area bordered on the north by the Missouri, on the south by the Arkansas, on the east by the Mississippi and on the west by the Kansas rivers.

It is concluded that the evidence from all sources is preponderant in that the Osage tribe had formed in the place of its historic habitat. They probably started as a series of autonomous village units, and derived from the people that left the late prehistoric archaeological assemblages known as Marginal Mississippi and the Ozark Top-layer cultures in southwestern Missouri, northwestern Arkansas and southeastern Kansas and the Neosho focus in northeastern Oklahoma.

Contacts during the eighteenth century with the Missouri and Oto tribes, both of whom had Oneota archaeological cultures, is the best explanation for the Oneota-like assemblages on historic Osage sites of the same time period.

Microfilm $4.15; Xerox $14.00. 324 pages.

THE TIWI WOMEN OF MELVILLE ISLAND, AUSTRALIA.

(L. C. Card No. Mic 59-4619)

Jane Carter Goodale, Ph.D.
University of Pennsylvania, 1959

Supervisor: Carleton S. Coon

In much of the theoretical writings concerning the classification of Australian Aboriginal social structure during the past two and half decades, that of Melville and Bathurst Islands has often been mentioned in passing. In general most of the writers rely on the field work of Spencer in 1912 and 1913 and Hart in 1928-29, or on information supplied by Harney. Elkin and the Berndts have spent brief periods between 1946-48 on Bathurst Island. Most of Hart's work has not yet been published, and Spencer gives only a very brief account of the social organization.

Many conflicting statements have been made concerning the social organization of the Tiwi and it was obvious that more information was necessary. However, because of the controversy surrounding social organization in this complex northern area of Australia, I deliberately disregarded all theoretical references to Melville Island in the field and in the analysis, as well as any reference to the general problems of Australian social organization classification, for I believe that the most valuable contribution I can make is to increase the amount of empirical data concerning this culture. I feel that for a preliminary study the facts should speak for themselves.

The field work was carried out during the period of April to December 1954 in the Snake Bay Native Settlement on Melville Island. Most of the information relating to topics discussed here is based on direct observation. I relied greatly on women informants, but most information was also checked with male informants. The reports of previous field workers were also checked. Checking of what Harney previously published about the island was

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

facilitated by Harney's presence as a member of our own field party. He did much of the rechecking and insisted that I also recheck his material independantly.

Use of the life-cycle of women as a frame work for discussing Melville Island culture, occurred to me in the field with the growing realization that an analysis of the funeral ceremony might well produce important clues for clarifying the social organization picture. And it happens that a third of my time in the field was devoted to studying this topic.

By letting the facts speak for themselves I believe that a number of interesting results were achieved. One relates to the Tiwi concept of "Dreaming" which is here equated with the father's matrilineal descent group as well as with spirit localities. Noteworthy, also, is the preferred marriage for both men and women with members of their father's matrilineal sib. Another finding is the necessary discrepancy in age between husband and wife which results from the marriage contract being made between a young man and his mother-in-law at the time of the latter's puberty ceremony. Specially pertinent to the positions taken by previous writers is the role of a patrilineal descent group in the major rite-of-passage, the funeral ceremony. Also pertinent is the inter-relationship of the matrilineal and patrilineal descent groups in the kinship system as revealed by the special system of kinship terminology associated with this ceremony.

In conclusion, I feel that the position of Melville Island culture in the general Australian aboriginal picture can now be clarified by comparison with similar studies on the mainland. I attribute its peculiarities to isolation alone, and important among them is the social equality of men and women and the individualistic orientation of the society. Microfilm $4.45; Xerox $14.80. 345 pages.

SAN MIGUEL ACATÁN, HUEHUETENANGO, GUATEMALA: A MODERN MAYAN VILLAGE.

(L. C. Card No. Mic 59-4007)

Francis Xavier Grollig, S.J., Ph.D.
Indiana University, 1959

San Miguel Acatan is a typical, primitive, modern, Mayan Indian community in the Highlands of Huehuetenango, the northwestern Department (State) of the Central American Republic, Guatemala. This thesis (statement) is based on a year of travel and study in Mayaland – Yucatan (Mexico), British Honduras, and Guatemala. The dissertation is the proof of the thesis.

The author, Father Francis X. Grollig, a Jesuit priest, was granted by the Governments of the United States and Guatemala a research award under the terms of the Buenos Aires Convention for the Promotion of Inter-American Cultural Relations. The grant was for one year of ethnological fieldwork in Guatemala. Most of this time (1958) was spent in the Highland area, in Huehuetenango.

Having studied in more than twenty Mayan villages, the author is able to present San Miguel Acatan as a typical community, and this on the basis of empirical data. The statistics, based on the official (1950) Guatemalan census, indicate that San Miguel is a primitive (illiterate) community. Four hundred years of contact with the Spaniards have westernized the Indians to a degree, but the recent intrusion of mining activities and highway construction projects – the Pan-American Highway goes right through the Department of Huehuetenango – has greatly accelerated the pace of acculturation and given a new meaning to modern as a term descriptive of these Mayan Indians. That they are Mayan Indians, of course, cannot be doubted, for they speak Kanjobal, a dialect of the Mam group of the Mayan language.

The Department of Huehuetenango was chosen for the field work because the (American) Maryknoll Missionaries have more than a dozen stations out in these mountain villages, and they extended a cordial invitation to Fr. Grollig to make these mission stations his "home" in Guatemala. He did, and consequently the friendship and cooperativeness of the Indian informants was simply an extension of their friendship toward the Padre in their respective villages: good rapport came automatically, especially in San Miguel Acatan.

This is an isolated village set in the vast, wonderful, and magnificent Cuchumatanes Mountains. The general ecology of San Miguel and its facilities are spelled out in the dissertation; so, too, are the political structure and the religious composition of the village.

With regard to the Miguelaneans, descriptive material is provided on their houses, furniture, clothes, language, and the social organization they live in.

The agricultural orientation of the Mayan Indians has perdured from the days of their great Civilizations. The agricultural cycle is traced, but account is also taken of the other industries, services, and occupations to which some of the Miguelaneans devote their time.

The life cycle is traced, and attention is drawn to the land which has been described as one without teen-age problems because there are no teen agers.

Finally, a section treats of the superstitious practices still indulged in by some of the Indians.

The fourteen tables incorporated into the text are based on original field data; the nineteen tables placed in the appendix are built from statistical data of the official national census (1950) of Guatemala.

Microfilm $3.00; Xerox $10.20. 229 pages.

BASKETMAKER CAVES IN THE PRAYER ROCK DISTRICT, NORTHEASTERN ARIZONA.

(L. C. Card No. Mic 59-3763)

Elizabeth Ann Morris, Ph.D.
University of Arizona, 1959

Supervisor: Emil W. Haury

In 1931, archaeological investigations were conducted in the Prayer Rock caves of northeastern Arizona by Earl H. Morris under the auspices of the Carnegie Institution of Washington. The work was concentrated in Broken Flute, Obelisk, and Pocket Caves, Caves 1 and 2, and several nearby rock shelters. About 3,000 stone, pottery, and perishable artifacts were found and information was obtained on the nature of the architectural remains. The predominant prehistoric complex represented was the Basketmaker III period of the Anasazi culture. The

present study is a detailed analysis of this large collection which was only partly reported by Morris.

The history of the Basketmaker concept is traced from its initial recognition in 1893 through various refinements to its usage at the present time. The Prayer Rock sites provide an unusually complete picture of the Basketmaker III period, because domestic artifactual and architectural remains are found in dry caves in which perishable materials are well preserved. The architectural remains consist of large complex pithouses placed in a row along the length of each cave. They characteristically include hearth, floor pockets, interior cists, radial partitions, bench, four roof supports, and wall timbers overlaid with reeds, bark, and mud. The entries were through the roofs, side entrances being suggested in only a few instances.

The material culture was analyzed in several ways to focus on several interpretive devices utilized in archaeological studies. The specimens are described in morphological groups by material as a basic referential ordering. They are then considered in postulated functional groups to order them in the way that the Basketmakers might have seen them. Finally, they are examined by the household units in which they were found in an attempt to establish the inventory of material culture expectable in an average Basketmaker house. The utility of these approaches is evaluated in terms of the goals of the study of prehistory. These include the establishment of spatial and temporal frameworks within cultural areas, and the reconstruction of the way of life of the people whose remains are being studied.

A comparative analysis of Prayer Rock Basketmaker and other Basketmaker remains in the Anasazi region provides the basis for establishing subareas. Differences in pottery and in architecture in the recorded sites proved to be the most useful criteria for assessing these geographic variations. The Basketmaker III cultural complex is portrayed as an emergence from the Desert Culture with its adaptation to a semiarid environment, after the addition of maize agriculture, ceramic technology, the bow and arrow, and other traits to the cultural inventory. The Basketmaker III level of development is seen as the base for the Anasazi cultural efflorescence of Pueblo III times. Microfilm $10.20; Xerox $36.40. 808 pages.

TILLAMOOK PREHISTORY AND ITS RELATION TO THE NORTHWEST COAST CULTURE AREA.

(L. C. Card No. Mic 59-4317)

Thomas McClellan Newman, Ph.D.
University of Oregon, 1959

Adviser: L. S. Cressman

The purpose of this thesis is to examine the archeology of the Tillamook, to place this group in the cultural historical perspective of the Oregon coast, and to explore their relationship to the Northwest Coast Culture Area.

Important organizational considerations are environment and its cultural implications; the data utilized, their source and method of utilization; a discussion of the significance and relationships of the various sources and kinds of data; and, finally, the conclusions expectable. The conclusions are offered as hypotheses which can serve as problems for future research.

Three principal sources of archeological data furnish the basis of the thesis. The first, and most important, is that derived from three seasons of intensive archeological investigations on Netarts Sand Spit, Tillamook County, Oregon. During the course of these investigations six house pits were extensively tested, and two completely excavated. Knowledge relating to village and subsistence patterns, types and manufacturing techniques of structures, and artifact typologies based on substantial numbers of artifacts was derived from this archeological site. Chronology, based both upon cultural and geological stratigraphy and radiocarbon dates, was determined, and the nature and sequence of occupations at the site are now known. Comparisons of house types, artifacts, and subsistence patterns through time presents a convincing picture of cultural change in the Tillamook area.

A second source of data is that derived from excavations at a small village site near Langlois in Curry County, Oregon. This site revealed the structural features, artifact typology and suggested the nature of prehistoric cultural manifestations on the southern Oregon coast. Chronologically, this site was placed as a single village occupation during late prehistoric times.

The third source of data consists of published and unpublished reports of archeological work accomplished in the Northwest Coast Culture Area. Ethnographic and historic sources are also utilized.

The discussion which follows suggests bases of comparison and relates the various data to one another. Cultural relationships through time on the Oregon coast are considered, and the implications of Oregon coast prehistory to that of the Northwest Coast Culture Area are discussed.

The conclusions of the thesis, presented as hypotheses, are as follows:

1. No evidence has been found to date suggesting great antiquity for Northwest Coast cultures on the Oregon coast. A eustatic adjustment of sea level may have destroyed evidence of earlier occupations if such existed.

2. On the basis of house types and art forms, the Tillamook are clearly related toward the coastal Salish speakers to the north.

3. A fully developed Northwest Coast culture with plank houses and a full complement of artifacts is dated at about 1670 A.D. on the basis of radiocarbon dates. This culture is ancestral to the historic Tillamook.

4. The fully developed Northwest Coast culture is identified as Salish and is historically related to and probably derived from its linquistic cognates to the north.

5. The emergence of the Tillamook as a distinctive culture might be ascribed to penetration of the Chinook to the mouth of the Columbia, effectively separating the Tillamook from other Salish speakers on the Northwest Coast.

6. No direct historical relationship is seen between the cultures of the northern and southern segments of the Oregon coast. Cultural manifestations found from approximately the Coquille River in southern Oregon southward into California appear to form a related unit with an independent history. Microfilm $2.00; Xerox $6.00. 124 pages.

THE PHYSICAL ANTHROPOLOGY OF CEYLON.

(L. C. Card No. Mic 59-4662)

Howard Webster Stoudt, Jr., Ph.D.
University of Pennsylvania, 1959

Supervisors: Dr. W. M. Krogman
Dr. C. S. Coon

The purpose of this dissertation is to: (a) reduce and present the raw data on the physical anthropology of Ceylon obtained during the Ethnological Survey of the Colombo Museum in 1937-39, (b) summarize the geographical, historical and cultural data relevant to the human biology of Ceylon, (c) review those means by which human physical differentiation may have taken place in Ceylon, and (d) interpret the observed morphological differences in terms of historical, environmental (physical and cultural) and genetic factors.

Original anthropometric, anthroposcopic and cultural data have been presented for 643 Sinhalese (8 groups and 3 composite groups), 593 Tamils (9 groups and 2 composite groups), 138 Veddahs (2 groups and 1 composite group), 32 Moors, 35 Malays, 15 Kaffirs, and 134 Maldivians (2 groups and 1 composite group).

Anthropometric data include number, range, mean, standard deviation, coefficient of variation, and standard errors for 12 body measurements and indices, and 24 measurements and indices of the head and face. Raw differences between the group means were determined and the statistical significance of these differences were computed. The anthroposcopic data include number and percentage of subjects in each of the categories of 27 different morphological observations. The cultural data include information on occupation, economics, diet, caste, social group, religion, and biological relationship of subject's parents for each of the groups.

From a review of the literature, previous work on the physical anthropology of Ceylon has been evaluated, the geography of the island described, the history and culture of the peoples summarized, and the possible means of morphological differentiation reviewed.

The more important conclusions may be summarized as follows:

1) Sinhalese, Tamils and Veddahs differ markedly in phenotype. This differentiation is a direct and continuing result of their diverse racial origins.

2) The Veddahs as a physical type are now almost entirely extinct, having been absorbed by the Sinhalese and Tamils.

3) Ceylon Tamils physically resemble the South Indian Tamils from whom they are descended, but the immigrant Indian Tamil estate laborers of Ceylon represent an economically selected segment of the parent population characterized by small body size.

4) Up-country Sinhalese have larger, stockier bodies and a more Mongoloid facial appearance than do Sinhalese from the Low-country.

5) Sinhalese from the Dry-zone are consistently smaller in size and more slender in build than those from the Wet Zone. Much of this difference is ascribed to increased Veddah admixture in the Low-dry Zone.

6) Tamils from the calcium-rich, limestone region of Ceylon have broader and more massive bodies than do those living on the relatively poor, sandy soils of the coastal areas.

7) The urban, slum-dwelling Sinhalese from Colombo differ markedly in physical appearance from all other Sinhalese, being much more attenuated in bodily form, a direct result of a continuing nutritional deficiency.

8) Manual laborers in Ceylon are definitely more mesomorphic than those employed in agricultural pursuits. The difference is due to an increased muscular development of the former group, but also to a selective factor which tends to eliminate those persons less suited to arduous physical tasks.

9) The breeding practices of Ceylon, i.e. an inflexible caste endogamy coupled with a very strong preference for village or local area endogamy, and, ideally, cross-cousin marriage, have been of great importance in the formation of local physical types. While caste-village breeding units never completely fulfill the optimum conditions necessary for random genetic drift, there is little doubt that many of the anthropometric and morphological variations between geographical sub-racial groups have resulted from random change in the gene frequencies of such populations.

Microfilm $4.85; Xerox $16.20. 377 pages.

ASTRONOMY

THE SYSTEM OF VV CEPHEI.

(L. C. Card No. Mic 59-4615)

Laurence W. Fredrick, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. F. Bradshaw Wood

The astrometric and photometric observations of VV Cephei are presented. The material is then analyzed for parallax, absolute magnitude, orbital orientation and linear dimensions. The parallax is shown to be +0".004 or larger. The absolute visual magnitude of the M star is deduced to be -2, which disagrees with that deduced by luminosity criteria. This disagreement is explained by the presence of an alternating magnetic field. The ratio of the radii is found to be 0.06, while the shell about the B star is about three times larger than the B star. The solutions from a new method of "rectifying" the light curves are shown to be compatible with a solution of the color curve.

The variation in light of the M star is analyzed and shown to be made up of three distinct variations. The B star and its shell are irregularly variable. It is shown

that the eclipse ended in the ultraviolet light before it ended in the visual light.

It is pointed out that the sizes and masses are probably not as large as previously thought, but more observations are needed to settle this problem. The particular observations needed are pointed out in detail. The peculiar shell behavior shows that there is a certain degree of instability present

Microfilm $2.00; Xerox $4.60. 90 pages.

PHOTOELECTRIC PHOTOMETRY OF R CMA, AO CAS, AS ERI, AND XY LEO.

(L. C. Card No. Mic 59-4639)

Robert H. Koch, Ph.D.
University of Pennsylvania, 1959

Supervisor: F. B. Wood

Four eclipsing variables were observed with the photoelectric photometers on the 36-inch and 12.5-inch reflectors at the Steward Observatory of the University of Arizona.

R CMa was observed in yellow, blue, and violet light. The outside-eclipse variation is peculiar, but the three light curves still admit of a common solution. This solution differs from those previously found in a manner which suggests that gaseous streams within the system account for a few percent of the light.

AO Cas was also observed in yellow, blue, and violet light. Changes in the shapes of the light curves were noted and the outside-eclipse variations were studied during two observing seasons. In general, previous conclusions about this variation have been reaffirmed.

AS Eri was observed for two seasons in yellow and blue light. The outside-eclipse variation shows small seasonal changes and perhaps short-term changes are also present. A new solution is found which demonstrates the eclipses to be partial. Tie-in to the (B, V) system indicates the cool star to be a K-type subgiant.

XY Leo was observed in yellow and blue light over a four month period. The light curve is definitely variable but in many respects is well-behaved. A solution is possible in yellow but not in blue light. The solution differs conspicuously from that expected as a result of spectroscopic investigation.

Microfilm $2.00; Xerox $4.20. 78 pages.

THE BRIGHTNESS TEMPERATURE OF THE SUN AT THREE POINTS IN THE INFRARED.

(L. C. Card No. Mic 59-4948)

Edward Morris Lewis, Ph.D.
University of Michigan, 1959

The purpose of this study was to measure the brightness temperature of the sun in the neighborhoods of 3.7, 4.7, and 11 microns. The intensity of the solar radiation, as measured at several wavelengths in each of the three regions, was compared directly with the intensity of a calibrated source at the same wavelengths.

The solar intensity was measured by forming an image of the sun with the aid of the Francis C. McMath Memorial Telescope of the McMath-Hulbert Observatory on the entrance slit of a Perkin-Elmer Infra Red Spectrometer and by detecting the energy at selected wavelengths with a vacuum thermocouple. The output of the thermocouple was displayed, after suitable amplification, on a Brown self-balancing potentiometer.

A carbon arc, calibrated by comparing it with a black body, served as a comparison source. The image of the positive crater of the arc was focused on the entrance slit of the spectrometer by means of mirrors which formed an optical path equivalent to that which formed the image of the sun.

Tracings of the solar and comparison spectra were made in the 3.7, 4.7, and 11 micron regions. Corrections were determined and applied for stray light, for slow changes in the gain of the amplifier, and for the arms supporting the Cassegranian secondary mirror of the telescope. Further corrections were determined and applied to the solar measurements to account for the extinction of the radiation in the earth's atmosphere. The effect of Rayleigh scattering was determined by measuring the solar intensity at several zenith distances and extrapolating to the value at zero air-mass according to Bouguer's law.

Molecular absorption by H_2O, HDO, CO, and Co_2 occurs in the regions measured in this study. The energy requirements of the thermocouple preclude the use of slits sufficiently narrow to avoid the lines. The corrections were made by estimating the equivalent widths of the lines as given in published atlases and calculating the fraction of the solar beam absorbed by the lines. In all the cases the lines were on the flat or the square root portions of the Curve-of-Growth, so that the absorption is far from directly proportional to the atmospheric path length. Accurate corrections for telluric molecular absorption require profiles of the lines to be made with sufficiently high resolution to provide reliable equivalent widths throughout the course of the solar intensity measurements. This task is of very great practical difficulty because the lines are densely packed; in the 3.7 and 4.7 micron regions they have overlapping wings. Observations of the profiles were not made during this study.

At 3.7 microns the brightness temperature, corrected for atmospheric extinction, is 5236 ± 375°K. This is in satisfactory agreement with the theoretically derived temperature at this wavelength, 5542°, found by calculating the intensity emergent from a model solar atmosphere compiled by Minnaert.

At 11 microns the observed temperature of 4600 ± 300° agrees with the theoretical temperature of 4901° within the uncertainty of the measurements.

At 4.7 microns solar CO absorbs part of the emergent radiation. The abundance of CO and the conditions of the solar atmosphere were used to calculate the equivalent widths of the CO lines by the method of the Curve-of-Growth. With this data the intensity of the emergent beam was corrected to account for the CO. The brightness temperature, corrected for solar and terrestrial extinction, was found to be 4310 ± 496°, while the theoretical value is 5376°.

The large discrepancy between theory and observation

at 4.7 microns and the large uncertainty of the observations at the other two wavelengths are principally due to the difficulty in estimating the correction that is to be applied because of the telluric molecular absorption. The extent of these difficulties emphasize the importance of conducting future photometric solar research from outside the atmosphere of the earth.

Microfilm $2.00; Xerox $6.00. 121 pages.

BACTERIOLOGY

IMMUNOCHEMICAL STUDIES ON BLOOD GROUPS.

(L. C. Card No. Mic 59-731)

Peter Zachary Allen, Ph.D.
Columbia University, 1959

Supervisor: Professor Elvin A. Kabat

I Immunochemical Studies On The Nondialyzable Residue From Partially Hydrolyzed Blood Group A, B and O(H) Substances (Pl Fractions).

II Studies On The Cross Reactivity of Untreated and Partially Hydrolyzed Blood Group A, B and O(H) Substances With Type XIV Anti-Pneumococcal Horse Sera.

The nondialyzable residue of mild acid treated blood group A or B substance (Pl fraction) can give rise in humans to precipitins, specific for the APl and BPl fractions respectively. APl fractions differ from untreated A substance in that they are able to stimulate the formation of APl specific precipitins in group A as well as group O individuals. Similarly, BPl fractions differ from untreated B substance since they may give rise to BPl specific precipitins in group AB as well as group O subjects.

Anti-BPl precipitins are specific for groupings present in B substance which are exposed by mild acid hydrolysis, since untreated B preparations show little or no reactivity with anti-BPl sera but acquire this capacity following mild acid treatment. Hog A substances, likewise show no capacity to remove anti-APl precipitins unless subjected to mild acid treatment. A single human A substance tested, however, was found to possess APl specificity prior to treatment.

Quantitative oligosaccharide inhibition studied indicate that BPl specificity is partially determined by terminal nonreducing α galactosyl residues. These α galactosyl determinants of BPl specificity appear to be involved in a linkage different from that of α galactosyl determinants of blood group B specificity since melibiose which is very effective in inhibiting B-antiB precipitation, is a poor inhibitor of BPl-antiBPl precipitation, being even less effective in this system than galactose. Thus the α galactosyl residues of BPl determinant groupings are probably not in 1 $\rightarrow$ 6 linkage. Limited inhibition studies show anti-APl to differ in specificity from anti-A since N-acetylglucosamine is able to inhibit APl-antiAPl precipitation but shows no inhibitory capacity in the A-antiA system.

The ability of B and BPl fractions to precipitate anti-B is independent of the capacity of the same preparations to remove anti-BPl precipitins. In agreement with inhibition studies, this suggests that groupings determining BPI specificity are distinct from those groupings conferring blood group B activity. In addition, time-hydrolysis studies of human B substance at pH 1.62, 1.32 and 1.10 show that reactivity with type XIV horse antipneumococcal sera as well as reactivity with human anti-B and anti-BPI sera are affected in a different way for each specific antiserum further indicating separate, distinct structural groupings to be associated with B, BPI and type XIV cross reactivity.

The capacity of sugars of known structure to inhibit precipitation of type XIV antibody from two different samples of horse antiserum by blood group substances and their Pi fractions was assayed by the quantitative inhibition technique. Of the compounds tested, the β galactosides 1 $\rightarrow$ 4 β N-acetylglucosamine, galactosyl 1 $\rightarrow$ 3 β N-acetylglucosamine and lactose were found on a molar basis, to be the most potent inhibitors of precipitation by intact and mild acid treated preparations.

The relative inhibitory capacity of β galactosides was found to vary with the particular sample of horse anti-XIV employed and in addition varied for individual preparations when tested with the same antiserum. Inhibition findings do not permit a definitive conclusion regarding the linkage of terminal galactosyl substituents conferring type XIV cross reactivity to blood group substances.

The liberation of greater amounts of galactose and N-acetylglucosamine from the Pl fraction by enzymatic treatment together with the increased potency of galactose over N-acetylglucosamine in inhibiting the cross reaction, suggests that the increased type XIV reactivity of the Pl fraction results from exposure of additional terminal β galactosyl rather than N-acetylglucosamine end groups.

Evidence that BPl and type XIV cross reactive sites are conferred by different kinds of galactosyl groupings on the B substance was obtained from quantitative precipitin data showing the capacity to precipitate anti-BPl to be independent of type XIV cross reactivity. Moreover while enzymes of Cl. tertium destroy type XIV reactivity they leave BPl reactivity intact.

Microfilm $2.00; Xerox $5.00. 97 pages.

RNA METABOLISM OF PHAGE INFECTED PROTOPLASTS.

(L. C. Card No. Mic 59-4489)

Tamar Ben-Porat, Ph.D.
University of Illinois, 1959

Most of the experiments described in this paper are concerned with the RNA metabolism of phage infected E. coli protoplasts.

The advantages of protoplasts in studies of this kind lie mainly in their sensitivity to osmotic lysis and to the ease with which they can be disrupted by mechanical means.

In preliminary experiments the protoplast-phage system was compared with the bacteria-phage system. Intact cells and penicillin protoplasts derived from them were found to behave identically as far as adsorption, growth, and burst size of phage are concerned. Also, the characteristic metabolic changes induced by infection in intact bacteria were observed upon infection in protoplasts. Normal protein synthesis, as measured by β-galactosidase, is stopped; DNA synthesis proceeds at a linear rate, but no net RNA synthesis is detectable. The patterns of incorporation of label into RNA and DNA of infected protoplasts are identical to the ones described for cultures of infected bacteria.

Infected and noninfected protoplasts were disrupted and by differential centrifugation three fractions were obtained — 15G15P, 100G120P, 100G120S.

The distribution of RNA in these fractions was compared. No changes in the composition of the three fractions studied could be detected.

The kinetics of incorporation of P^{32} and labeled C^{14}-uridine into the fractions of infected protoplasts is somewhat different from that of normal protoplasts. Although the specific activity of each fraction is comparable to the corresponding one in noninfected protoplasts, the labeling of the fractions ceases after the first few minutes.

When pulse experiments with labeled C^{14}-uridine were performed, it was found that whereas the RNA of the "membrane" fraction (15G15P) and the supernate fraction (100G120S) behaved similarly in infected and noninfected protoplasts, the "particle" fraction (100G120P), which comprises about 80 per cent of the cellular RNA, behaved in a different manner. In noninfected protoplasts this fraction accepts label found previously in the "membrane" fraction. In infected protoplasts, on the contrary, a loss of label from this fraction occurs.

The "particle" fraction comprises most of the RNA of the cell and its behavior will, therefore, dominate quantitatively the observed pattern of incorporation into the RNA of the whole cell. The possibility that this pattern of incorporation is due to the instability of the particles synthesized subsequently to infection is discussed.

Microfilm $2.00; Xerox $5.60. 115 pages.

THE EFFECT OF METABOLITES OF SEVERAL BACTERIA ON THE GROWTH AND TOXIN PRODUCTION OF CLOSTRIDIUM BOTULINUM TYPE A.

(L. C. Card No. Mic 59-4440)

Francis Daniel Crisley, Ph.D.
University of Pittsburgh, 1959

Despite the ubiquitous nature of Clostridium botulinum, botulism is a rare disease. To account for this, the results of past workers suggested that many coexisting microorganisms may inhibit development of C. botulinum and/or its toxin in spoiled canned foods, the soil, and the intestinal tract. Enhancement of this anaerobe's activities by a few organisms has also been reported.

C. botulinum growth in mixed cultures usually follows initial growth by concomitants. This investigation was undertaken to determine the effects of metabolites of four representative concomitants, Bacillus sphaericus, Clostridium sporogenes, Escherichia coli, and Streptococcus faecalis on growth, glucose uptake, toxin production, cell lysis, and spore germination of C. botulinum.

Phosphate buffered and unbuffered versions of a complete medium were employed; the latter was used for producing bacterial filtrates. C. botulinum response in filtrate-containing media was compared to that in similar media with equivalent dilutions of fresh unbuffered medium and in media with no additives. The concentration of growth media was kept constant throughout all experiments.

Turbidimetric measurements of C. botulinum growth in serial filtrate dilutions in buffered and unbuffered media showed acid inhibition by high concentrations of S. faecalis metabolites in the latter. Direct nutritional competition with C. botulinum for similar components was indicated by C. sporogenes and to a much smaller extent, B. sphaericus. E. coli and S. faecalis filtrates contained factors utilizable by C. botulinum thus indicating less specific competition by these organisms. Filtrate dilutions, designated "toxicity test dilutions," at which the effect of metabolites on botulinum growth was minimal, were estimated.

C. botulinum glucose utilization in buffered medium containing "toxicity test" dilutions of filtrates was determined by paper chromatography. Glucose disappeared from all cultures, including controls, by 24 hours. Preferential utilization of nonglucose components was demonstrated at 8 and 12 hours in control cultures containing added fresh unbuffered medium. C. sporogenes metabolites significantly stimulated glucose consumption up to 12 hours with slight indications of a similar mechanism in B. sphaericus filtrate, and a transitory increase at 8 but not 12 hours in faecalis filtrate. E. coli metabolites exerted no significant influence.

The influence of high and "toxicity test" concentrations of metabolites on toxigenicity was measured in 96 hour botulinum culture centrifugates by determining their 50 per cent lethal doses in goldfish. The only significant effect noted was an increased toxicity in buffered medium containing high (1:2) dilutions of S. faecalis filtrate. This was found to be due to the combined influence of high filtrate-high phosphate concentrations, not pH or the buffering capacity of the medium.

Lysis in 96 hour cultures and in washed botulinus cell

suspensions in buffer alone and with added filtrates and fresh medium was measured turbidimetrically. C. botulinum autolytic enzymes were found to be oxygen-labile. B. sphaericus and C. sporogenes filtrates possessed heat-labile factors which increased botulinum lysis at all concentrations. E. coli and S. faecalis metabolites inhibited lysis at 1:2 but not at 1:8 dilutions.

Spore germination in buffered medium-filtrate and control suspensions was determined by changes in the light transmittance at various time intervals. All filtrates were inhibitory to germination and could be arranged in increasing order of effect as follows: E. coli, B. sphaericus, S. faecalis, and C. sporogenes. C. sporogenes metabolites contained an additional factor which impaired the vegetative outgrowth of germinated spores.

It is felt that the metabolites of the bacteria studied could exert sufficient suppressive control on the various aspects of C. botulinum development to account for significant impairment or complete inhibition of its toxigenicity in environments in which these organisms are important concomitants.

Microfilm $2.00; Xerox $5.40. 110 pages.

PHYTO-ONCOLECTINS: ANTITUMOR FACTORS DERIVED FROM SELECTED PLANT SEEDS.

(L. C. Card No. Mic 59-4919)

Richard Francis Haines, Ph.D.
University of Michigan, 1959

Certain plant extracts are included among naturally occurring substances with known deleterious effects on tumors. Many of these extracts, however, also exhibit decided tendencies to agglutinate erythrocytes, a highly undesirable property if oncotherapeutic use of such materials were contemplated. Three types of bean seeds were used in this study for the purpose of investigating the possibility of separating and characterizing their antitumor factors and those responsible for hemagglutination. Crude extracts of these seeds were essentially equally capable in vitro of preventing growth of the Flexner-Jobling rat carcinoma and yet differed in their ability to agglutinate rat erythrocytes.

The premise followed initially was that reported by others: hemagglutination and tumor protection are probably correlated and due to extractable proteinaceous (globulin) constituents of the seeds. Therefore, optimal extraction conditions for proteins were determined. Ionic strength, pH, ratio of solvent volume to sample weight, extraction time and temperature, repeated extractions, lipid pre-extraction, and mode of stirring were all found to influence the amount of protein extracted. Electrophoretic analysis of protein-containing extracts of the three seeds showed distinct differences in their components, suggesting an explanation for their hemagglutination dissimilarities.

Pre-extraction of the seeds with organic solvents led to less protective lectins, suggesting the role of lipids, probably as chemical complexes. The lability of prepared lectins was also demonstrated as was variation in biological activity by seed lot. Preliminary biochemical indications were that lectin activity consisted of a dual nature, i.e., at least two entities in crude extracts each of which was independently protective but partially reciprocally neutralizing when combined.

Of various crude preparations tested, aqueous extracts were the most protective indicating a nonglobulin nature of the antitumor factors. Ammonium sulfate fractionation of crude saline extracts disclosed that the protective principle was contained in the nonprecipitable fraction. Chemically, these fractions were found to be completely or nearly free of nitrogen, depending on the seed examined. It was also shown that approximately 75% of the seed meals was carbohydrate in nature such that materials of this type would account for the major portion of aqueous extracts. These findings substantiated the nonprotein nature of the protective factors.

An additional and refined selective successive extraction technique established that hemagglutination was caused by saline-soluble proteins, probably globulins, and protection largely by nonprotein materials. A third biological activity, hemolysis, was shown to be due to ethanol-soluble substances.

Attempts to isolate the protective principles included both indirect and direct approaches. In the former case, i.e., precipitation of the undesired proteins from crude seed extracts, zinc acetate and mercuric acetate were shown to be ill-suited for this purpose. Protein removal by full saturation with ammonium sulfate proved to be the best indirect method tested. In this instance, although the yields of nonprotein substances were very low their protective activities were of a high order. The direct extraction of nonprotein materials was best accomplished by trichloroacetic acid. Yields of the final products were increased by this means, but their biological activities were somewhat less than the ammonium sulfate preparations. However, the specific activity of materials extracted thus was increased by ethanol fractionation.

The collective biological and biochemical evidence strongly suggests the presence of common extractable antitumor substances in the three seeds studied. These substances can be successfully freed of contaminating materials responsible for hemagglutination. It is concluded that the antitumor materials are of a probable complexed character and may be lipopolysaccharide in nature.

Microfilm $2.05; Xerox $7.20. 155 pages.

THE SUPPRESSED MULTIPLICATION OF TUBERCLE BACILLI WITHIN MACROPHAGES DERIVED FROM TRIIODOTHYRONINE-TREATED GUINEA PIGS.

(L. C. Card No. Mic 59-4633)

Hsiu-Sheng Hsu, Ph.D.
University of Pennsylvania, 1959

Supervisor: Stuart Mudd

In the observation that hyperthyroidism, as induced by triiodothyronine or thyroxine, increased the resistance of certain strains of inbred rabbits to experimental tuberculosis, Lurie hypothesized that hyperthyroidism altered the cellular physiology and thereby increased the bacteriostatic capacity of macrophages. The purpose of this

study was an attempt to test, in part, the validity of this hypothesis.

Exudative monocytes from normal guinea pigs or guinea pigs treated with triiodothyronine were infected with either of two strains of tubercle bacilli (H37Rv), and maintained in tissue culture. A technique was devised to follow quantitatively the viable intracellular tubercle bacilli. Since 0.5% sodium desoxycholate was found to cause immediate disintegration of leucocytes upon contact and yet had no effect on the viability of the tubercle bacilli, this concentration of sodium desoxycholate was used to disrupt the infected monocytes and allow recovery of viable intracellular tubercle bacilli.

The two strains of H37Rv used in this study demonstrated different ability to multiply within the monocytes from normal guinea pigs. The "Phipps" strain showed an initial lag phase of approximately 5 days, which was followed by a growth phase with a 4 fold increase within the next 2 days, but with little change there after. This intracellular growth appeared to be somewhat suppressed by the monocytes from triiodothyronine-treated guinea pigs. The "Steenken" strain of H37Rv, on the other hand, began to multiply within 2 days after phagocytosis, and continued to multiply constantly with a generation time of 2-3 days throughout a 9 day period. This same strain showed a lag period of approximately 2 days when grown in monocytes from triiodothyronine-treated guinea pigs, and this was followed by a much slower rate of multiplication (generation time of 5 days or more).

It was, therefore, demonstrated that an increase in "cellular resistance" was induced by a single biochemically defined entity, and that specific humoral factors apparently did not play a prominent role in this system.

Microfilm $2.00; Xerox $3.00. 26 pages.

THE MECHANISM OF RESISTANCE TO PURINE ANALOGUES IN SALMONELLA TYPHIMURIUM.

(L. C. Card No. Mic 59-4637)

Gurudutt P. Kalle, Ph.D.
University of Pennsylvania, 1959

Supervisor: J. S. Gots

Studies on the mechanism of resistance to purine analogues consisted of three phases:

1. A general survey of action of the analogues and the reversal of inhibition by purines.
2. Isolation of mutants of Salmonella resistant to purine analogues and study of cross-resistance.
3. A detailed study of resistance to 2,6-diaminopurine (DAP).

More than one purine was found to be capable of reversing the inhibition by any given analogue. A considerable amount of cross-resistance is shown by the mutants resistant to purine analogues. Resistance to a purine analogue is also accompanied by an increased sensitivity (collateral sensitivity) to some of the other purine analogues. Two types of DAP-resistant mutants were studied in detail for determining the mechanisms of resistance to this analogue. One type LT-2/DAP-3 was also resistant to 8-azaxanthine, 2-thio-6-oxypurine, 8-azadiaminopurine, 2-aminopurine, thioguanine, and adenine. The other type LT-2/DAP-6 was resistant to 6-mercaptopurine and exhibited collateral sensitivity to adenine.

Two biologically active compounds were isolated from the culture fluid of LT-2/DAP-3 and identified as adenine and uracil respectively, which prevent the inhibition of S. typhimurium LT-2 by DAP and adenine. The LT-2/DAP-3 was further found to be deficient in its ability to incorporate adenine-8-C^{14} and DAP-2-C^{14}. The uptake of guanine-8-C^{14}, hypoxanthine-8-C^{14} and xanthine-8-C^{14} was not appreciably affected. The LT-2/DAP-6 incorporated adenine but lacked the ability to remove DAP from the medium. The DAP-resistant mutants carrying DAP-3 mutation were derived from purine requiring auxotroph of Salmonella, adeE-11 and were found to excrete uracil. Conversely, a uracil deficient mutant carrying DAP-3 mutation was found to excrete adenine. The mutants of adeE-11 resistant to DAP were deficient in their ability to remove purines from the medium, whereas the uracil or cytosine uptake was not affected in the resistant mutants of uracil requiring auxotrophs.

The excretion of adenine in DAP-3 type of mutant was not due to a defect in the feed-back regulation of purine biosynthesis. This was shown by the studies on the feed-back inhibition of accumulation of 5-amino-4-imidazole carboxamide ribotide (AICAR) by adenine in E.coli B96/1, which requires a purine and tryptophane for growth, and in the sulfonamide-inhibited cultures of LT-2 and LT-2/DAP-3. Higher concentrations of adenine required by LT-2/DAP-3 to exert 50% inhibition could be adequately explained by the lower rate of incorporation by the mutant.

The extracts of LT-2 and its DAP-resistant strains lacked the enzyme needed for converting DAP to its nucleotide. The activity for adenylic pyrophosphorylase was lower in the resistant mutants. The LT-2/DAP-3 extracts showed the same activity for inosinic pyrophosphorylase as LT-2, whereas LT-2/DAP-6 had the lower activity for this enzyme.

Studies indicate that there are at least two pyrophosphorylases; one for adenine and the other for hypoxanthine. The resistance to DAP in both the mutants is due to deficiency in DAP-nucleotide pyrophosphorylase. The excretion of adenine and uracil are not per se responsible for resistance in DAP-3 type of mutants. The mechanisms by which these nucleic acid components are excreted are not clear.

Microfilm $2.00; Xerox $3.00. 60 pages.

STUDIES ON AN AUTOTROPHIC BACTERIUM OXIDIZING FERROUS IRON AND ELEMENTAL SULFUR IN ACID MEDIA.

(L. C. Card No. Mic 59-4455)

Norma Ann Kinsel, Ph.D.
University of Pittsburgh, 1959

An obligate autotrophic bacterium was isolated from bituminous coal mine drainage and characterized. The organism was a gram negative, nonsporing, motile rod oxidizing ferrous iron and elemental sulfur in acid media. Ammonium sulfate served as a better source of nitrogen for the organism than urea, peptone or potassium nitrate.

Iron oxidation was optimum at pH 2.85 and 32°C. The organism survived 50°C. for 15 minutes but not for 30 minutes when suspended in iron medium at pH 2.68.

The iron oxidizing ability of the organism was not lost by serial transfer through sulfur medium nor was the sulfur oxidizing ability of the organism lost by serial transfer through iron medium. The utilization of two energy sources was also indicated from a dilution study. In this experiment, diluted aliquots from an oxidized iron culture contained similar numbers of organisms capable of utilizing iron or sulfur as energy sources.

A close relationship existed between the organism and the oxidation of iron. Increases in cell numbers and in total cell protein material depended on the amount of iron oxidized. The minimum efficiency (calculation was based on the amount of carbon in cell protein material and not on total carbon content of cells) of the organism in utilizing energy released from the oxidation of iron for carbon dioxide reduction was 5.21 per cent.

Several factors were found to effect the oxidation of iron. The iron oxidizing capacity of the organism was increased by agitation and growth factors (vitamins and trace metals). Cultures incubated in an atmosphere of 10 per cent carbon dioxide showed increased oxidation rates as compared with cultures incubated in the normal atmosphere.

Iron oxidation was determined qualitatively with potassium ferricyanide and potassium thiocyanate. Quantitative determinations of iron oxidation were made with potassium dichromate. Sulfur oxidation was followed by pH, titratable acidity or sulfate determinations. Cell protein material was determined colorimetrically with the Folin-Ciocalteau reagent. Numbers of organisms were determined by the dilution method.

The organism described in this investigation resembled Thiobacillus thiooxidans, Thiobacillus ferrooxidans, and Ferrobacillus ferrooxidans in many morphological and cultural characteristics. It was distinguished from T. thiooxidans by the oxidation of ferrous iron and from T. ferrooxidans and F. ferrooxidans by the oxidation of elemental sulfur.

Microfilm $2.00; Xerox $3.00. 58 pages.

AN INVESTIGATION OF SURFACE ANTIGENS OF MAMMALIAN TISSUE CELLS GROWN IN VITRO.

(L. C. Card No. Mic 59-4942)

Joseph Hiram Kite, Jr., Ph.D.
University of Michigan, 1959

A partial immunological characterization was initiated of the surface antigens of a stable cell strain (Strain L mouse fibroblast) grown in tissue culture. Interest was directed toward the recognition of groupings shared with other cell strains, and also toward an analysis of the antigens of this one cell line. Such studies are of value in attempting to compare tissue cell strains of different types or ones isolated from different tissues. Also they may further an understanding of alteration in cell structure due to viruses or autoimmune mechanisms as well as alterations frequently observed to occur spontaneously in tissue culture.

Agglutination, complement-fixation, and metabolic-inhibition reactions were used to compare the reactivity of different cell strains and their antisera. Two lines of mouse fibroblasts (Strain L and LLC-M_1) cross reacted almost completely with each other. Two cell lines of human epithelial cells (HeLa and Chang's liver) likewise cross reacted to a high degree. Only a low order of cross reaction was observed between either mouse fibroblast and either of the human epithelial cells. No antigenic differences were detected between Strain L and LLC-M_1 mouse fibroblasts. Thus species specificity but not tissue or organ specificity was detected. Metabolic inhibition titers between fibroblasts (Strain L or LLC-M_1) and their homologous inactivated antisera were found to be low but independent of the action of guinea pig serum. With the addition of guinea pig serum the inhibition titer increased five fold. On the other hand, low inhibition titers between epithelial cells (HeLa or Chang's liver cells) and their homologous antisera were not increased with the addition of guinea pig serum. In the latter case, the low cytotoxic titer did not parallel the high complement-fixing ability of the cells. Proposed explanations for the variation in cytotoxic effect between cell lines included a deficiency of complement components and a difference in structure of the cell membranes.

L strain cells were treated with several enzymes or chemical agents known to have rather specific effects on certain chemical groupings. Treated cells were then tested for their ability to be agglutinated by homologous antiserum to whole, untreated cells. It was found that sodium periodate or lipase completely abolished the agglutination of whole cells with their homologous antisera. Trypsin in low concentration increased the titer but with increased concentration or exposure time, there was an agglomeration of cells. As an alternate approach, a variety of procedures were used to extract antigens from the Strain L fibroblasts, with emphasis upon obtaining extracts of differing chemical composition (i.e. protein, carbohydrate, lipid). Interest was centered upon a "glycolipid" extract which was found to stimulate the production of agglutinating and complement-fixing antibodies reacting with the whole cell. The results of the enzymatic studies and the analysis of the extracts suggested the importance of carbohydrates and lipid in the constitution of surface antigens. Microfilm $2.00; Xerox $5.00. 99 pages.

RADIATION RESISTANCE IN BACILLUS CEREUS.

(L. C. Card No. Mic 59-4727)

William Charles McDonald, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Orville Wyss

An attempt was made in this study to determine some of the factors responsible for the inherent radiation resistance of the endospores of Bacillus cereus. It was felt that a study of the effects of radiation, both ionizing and ultraviolet, on the colony forming ability, spore formation, and genetic stability of this organism might lead to a better understanding of the changes induced by the agents in its resistant and sensitive stages.

In preliminary phase-microscopic observations a difference in size and light refractivity of spores formed in distilled water and those formed in a complete medium was apparent. By observation of stained preparations, however, it was found that no significant difference in these spores existed.

A comparison of the radiation inactivation curves of B. cereus spores formed in distilled water, varying concentrations of glutamic acid, and nutrient agar showed some variation of the resistance of spores formed under these conditions to both ultraviolet and ionizing radiation. It appeared that spores raised in an increased glutamic acid concentration and on nutrient agar yielded a somewhat more resistant system.

In the studies described on the effect of the post-irradiation environment on induced mutants of B. cereus, Difco Brain Heart Infusion agar was found to be far superior to any other medium tested in the recovery of mutants. The failure of streptomycin resistant mutants to form visible colonies on media other than Brain Heart Infusion agar is apparently due to substances which inhibit a large number of mutants from actually forming colonies on the streptomycin medium. The majority of the mutants not recovered were of the small colony type.

Nuclear stains of our strain of B. cereus did not give pictures of nuclear events sufficiently clear to warrant an attempt to correlate them with the radiation studies. From other work on radiation damage it appears that genetic instability can be correlated with high nuclear activity. The data presented here show that the radiation induced mutagenic response of endotrophically sporulating organisms correlates precisely with the radiation killing curves. The readily mutabile vegetative cells exhibit a period of even greater radiation sensitivity preceding the time when they become radiation resistant. This resistance to the mutagenic as well as the lethal action of radiations is exhibited before the organism is cytologically recognizable as a spore or has acquired the heat resistance which is normally used to define the spore state. This period of increased sensitivity is due to some process or processes occurring during sporogenesis, and not the loss of protective material, such as RNA. Following this period the developing spore becomes refractive to the dose of radiation mutagenic for vegetative cells before developing heat resistance. The length of the delay in maximal expression of induced mutants was the same for mutants screened from spores of irradiated vegetative cells not permitted to sporulate. The effects were similar with ultraviolet and X-irradiation. Germinating mutant spores became heat but not penicillin sensitive at the same time as the non-mutant population implying a lag in the onset of division of the mutants. Microfilm $2.00; Xerox $4.60. 86 pages.

ANTIBODY FORMATION IN REPLICATING CELLS DERIVED FROM PERITONEAL EXUDATES OF RABBITS.

(L. C. Card No. Mic 59-4296)

John Morgan McKenna, Ph.D.
Lehigh University, 1959

A system has been described in which rabbit monocytes, derived from peritoneal exudates, produced antibody to protein antigens in tissue culture. In order to evoke the monocytes, rabbits weighing approximately 3 kg were injected intraperitoneally with 100 ml of sterile, highly viscous mineral oil (Drakeol 350) prewarmed to 37°C. When the animals were sacrificed three days after the oil injection, differential cell counts revealed an average of 74% monocytes in the exudates. The peritoneal exudate cells were planted at 5×10^5 cells/ml in medium 199_{75}: normal rabbit serum $(NRS)_{25}$, usually in roller tubes. Medium 199, supplemented with at least 25% NRS, was shown to be superior to Hanks' solution supplemented with 40% NRS as well as Trowell's Medium supplemented with 30% NRS. Hanks' solution did not support cellular multiplication for more than one week, and at least 25% NRS in a medium more complete than Hanks' solution was found essential in order that the monocytes produce antibody.

For studies of the primary response of the monocytes to bovine-γ-globulin (BGG), rabbits were injected intravenously with 40 mg of alum-precipitated BGG and were sacrificed four days later. Secondary responses were studied by giving rabbits 4 mg of alum-precipitated BGG intravenously six weeks after the primary dose mentioned above. These animals were sacrificed four days after the secondary intigenic stimulation. Cells taken from normal animals and exposed to 1.0 mg/ml of BGG in medium 199 were used in the completely in vitro system. Other animals received 11 intravenous injections of alum-precipitated BGG over a two-week period for a total of 110 mg of antigen. These hyperimmunized animals were also sacrificed four days after the last antigen injection and three days after the oil injection. Culture fluids were changed every 2-3 days, and the cells passed when their number exceeded 1.5×10^6/tube. The culture fluids were assayed for antibody by a pattern hemagglutination technique in which the antigen was adsorbed to the surface of formalinized, tanned sheep erythrocytes. These sensitized cells will agglutinate in the presence of antibody specific for the adsorbed antigen.

In all systems, the titers remained constant until a sudden fall, the time of which varied for each of the systems studied. The antibody titers for at least five experiments in each group averaged 30, 32, 26 and 147 for the primary, secondary, completely in vitro, and hyperimmune systems, and the antibody persisted for 21, 23, 13, and 9 days respectively. The lipopolysaccharide endotoxin of Salmonella typhosa appeared to make the monocytes behave as if they had been taken from hyperimmunized rabbits. This was true whether the endotoxin was injected together with a primary dose of BGG, or whether injected intravenously to a rabbit 24 hours before its peritoneal exudate cells were exposed to BGG in vitro.

Neither freshly harvested nor cultured monocytes were phagocytic in vitro for India ink (carbon) nor Salmonella typhosa, Escherichia coli, or Shigella paradysenteriae even

in the presence of immune serum. After approximately one week in culture, the monocytes assumed the elongate, angular shape of fibroblasts. However, the monocytes were larger than fibroblasts and formed syncytia rather than sheets of cells. Moreover, the monocytes did not stain with the bright green stain said to be characteristic of fibroblasts when Kalter's quadruple stain was used.

An attempt was made in the discussion to integrate the findings into general biological theory.

Microfilm $2.00; Xerox $5.20. 104 pages.

ANTIBODY RESPONSE OF CHICKENS TO AN ACUTE INFECTION OF EIMERIA TENELLA.

(L. C. Card No. Mic 59-5119)

Thomas David Moore, Ph.D.
The Pennsylvania State University, 1959

The serological responses of the domestic fowl to an infection with Eimeria tenella, a protozoan which parasitizes the caecum, has been studied using the direct and the indirect complement-fixation reactions. The detection of antibody in the chicken by the conventional direct complement-fixation methods employing heat-inactivated serum is precluded due to the thermolability of the antibody. The use of uninactivated serum by the same method is not reliable because of the high degree of non-specific fixation encountered in both normal serum and that from infected birds. By exposing the serum to a NaCl solution of 2.15% for a period of 24 hours, non-specific fixation can be largely removed.

Two antigens, consisting of a caecal extract and an oocyst extract, both concentrated by cold ethanol precipitation and fortified with cholesterol, were reacted with salt-treated serum in the presence of 1.5 full units of complement for 17-3/4 hours in the direct test.

Similar antigens were employed with a rabbit standard anti-serum for the indirect tests. Heat-inactivation of both the rabbit and the chicken serum was used for this procedure.

The results by the above methods show a definite progressive antibody response in birds infected with Eimeria tenella. Titers by the indirect technique are never as high as those of the direct method.

Attempts at reinfection were unsuccessful in producing overt symptoms of the disease although an increase in antibody was detected by the direct method.

It is suggested that the inability to detect antibodies by the complement-fixation test using heat-inactivated serum is due to a heat induced alteration in the antibody molecule. This structural change does not allow for the fixation of complement by an antigen-antibody aggregate.

Microfilm $2.00; Xerox $3.80. 70 pages.

STUDIES OF AN ENZYME EXTRACTED FROM BACILLUS FULMINANS WHICH INACTIVATES BLOOD-GROUP O SUBSTANCE.

(L. C. Card No. Mic 59-4200)

Ingeborg Flemming Naylor, Ph.D.
Tulane University, 1959

Chairman: Harold Baer

Bacillus fulminans is an aerobic, Gram-positive, non-motile bacillus classified as a variant of Bacillus cereus.

It has been established that Bacillus fulminans produces an enzyme which specifically destroys blood-group O substance, but is without effect on blood-group A and B substances when tested by inhibition of hemagglutination using immune anti-O serum derived from chickens or Ulex europeus seed extract and type O erythrocytes; commercial anti-A and anti-B sera and their respective cells were used for the determination of A and B activities.

The present work was initiated to study the mode of degradation of blood-group O substance by the enzyme and to correlate the findings as an aid to determine the basis for blood-group O specificity. It was thought that since blood-group substances of all types are identical in their qualitative chemical composition, a certain structural linkage may be responsible in determining the specificity. Preliminary experiments were designed to study the nature of the enzyme and to achieve, if possible, further purification. The original isolation was accomplished by precipitation with ammonium sulfate at 0.6 saturation and although an enzyme was recovered as shown by fractional precipitation procedures with ammonium sulfate, the resulting product was relatively impure as evidenced by: (a) its ability to hemolyze erythrocytes; (b) the presence of blood-group A activity, which is widely distributed in nature and in this case was probably derived from the medium; (c) the relatively large quantity, based on nitrogen content, required to inactivate the standard amount (50 μg) of blood-group O substance within the specified length of time (30 minutes). Further purification was accomplished by precipitation at pH 3.9 carried out by dialysis against phosphate buffer using the crude enzyme solution. The result was a preparation with an eight-fold increase of activity based on nitrogen content, absence of blood-group A activity, and loss of hemolytic activity. The enzyme of Bacillus fulminans was fully active over a rather wide range of temperatures up to 40°C; below 20°C the activity became very sluggish but could be demonstrated even at a temperature of 4°C. Above 40°C the activity fell off until destruction occurred after exposure to 85°C for ten minutes.

When tested against a variety of blood-group substances of human and porcine origin with A, O, or OA activities (either in a mixture or derived from a single animal), it was found that only the O activity was lost and that at least fucose was liberated which diffused through a cellophane membrane. The ratio of diffusible fucose of active to inactive (boiled) enzyme was found to be 6:1 when human O substance was used and 3:1 when blood-group substance OA isolated from lower animals was the substrate. No fucose was detectable in the diffusate from human blood-group A substance.

The purified enzyme preparation was capable of rendering O cells non-agglutinable by anti-O sera produced

in chickens, normal chicken sera with agglutinins for all types of human cells, and Ulex europeus seed extract. The agglutinability of A and B cells by commercial anti-A and anti-B sera respectively, was not altered.

The effects of sugars in inhibiting the action of the enzyme from Bacillus fulminans were studied, based on the observation that products of enzymic action may specifically inhibit the activity of the enzyme. The action of the enzyme on blood-group O substance was inhibited by L-fucose, D-galactose, D-galactosamine, lactose, L-arabinose, and melibiose. Of these lactose, L-arabinose and melibiose are not present in blood-group substances, but they are structurally related to D-galactose, L-fucose to the structure of L-galactose. The 4-beta- and 6-alpha linkages could be excluded on the basis of the behavior of melibiose and lactose, the carbon atom 6 on the basis of the action of L-arabinose, as the structures responsible for inhibition. The effect of alpha- or beta-configurations and the role of substitutions at carbons 3 and 4 are not yet determined. No sugar bearing structural resemblance to glucose was found to be active.

In summary, an enzyme extracted from Bacillus fulminans was found capable of specifically destroying blood-group O substance. The inactivation was accompanied by a preferential release of fucose.

The action of the enzyme renders human erythrocytes of group O non-agglutinable by anti-O sera. Fucose and certain galactose-derived sugars inhibit the action of the enzyme. Microfilm $2.00; Xerox $3.80. 69 pages.

AGGLUTINATION AND LYSIS TESTS WITH ERYTHROCYTES ADSORBED WITH A FRACTION OF VIBRIO FETUS.

(L. C. Card No. Mic 59-4558)

Miodrag Ristic, Ph.D.
University of Illinois, 1959

A substance HS, apparently polysaccharide in nature, was isolated from smooth V. fetus cells of bovine origin. The carbohydrates yielded only pentoses on hydrolysis. Seven amino acids were identified in the fraction. The fraction contained 14 per cent nitrogen and 6.5 per cent phosphorus. Immunologic reactivity of the fraction was demonstrated by production of agglutinating antibody in the rabbit and guinea pig. Fraction HS was serologically active in gel precipitation tests and was capable of inhibiting specific agglutination reaction. The fraction apparently represents a type-specific, O antigen common to a number of individual strains rather than a species-wide antigen.

Hemagglutination and hemolysis tests have been developed for detection of antibody against V. fetus. Sheep erythrocytes sensitized with a polysaccharide fraction of V. fetus were agglutinated and lysed by specific serums produced in rabbits, and by serums of naturally infected cattle. Cross-hemagglutination and cross-hemolysis reactions between two HS antigens and 18 strains specific V. fetus antiserums revealed the presence of two serologically heterologous antigens. The specificity of the hemagglutination reaction was shown by its inhibition by the free polysaccharide. The hemolytic test was found superior to the hemagglutination test in its ability to detect smaller amounts of antibody. Treatment of sheep erythrocytes with one of the antigens did not block the adsorption of the second antigen.

Some advantages, characteristics and principles concerning the hemagglutination and hemolysis tests are discussed.

Microfilm $2.00; Xerox $5.00. 96 pages.

AN EXAMINATION FOR PHAGE-MEDIATED GENETIC TRANSFER MECHANISMS IN STAPHYLOCOCCUS AUREUS.

(L. C. Card No. Mic 59-4040)

Robert Louis Stone, Ph.D.
Indiana University, 1959

Experiments designed to detect transduction or conversion in Staphylococcus aureus were conducted. Twenty-five staphylococcal typing phages and twenty-one additional temperate phages isolated in this study were employed. Twenty-nine strains of S. aureus or mutants isolated from these strains were utilized. Nutritional mutants were obtained by replica plating techniques following ultra-violet irradiation. Fermentation mutants were isolated following irradiation on neutral red carbohydrate media developed in this study. Streptomycin-resistant and dependent strains were obtained from spontaneous mutants growing on selective media.

Tests for non-prophage-linked transduction were conducted by growing phage lytically in donor bacteria and plating incubated mixtures of the phage and recipient mutant bacteria on appropriate selective media. Control platings of bacteria alone were scored for spontaneous mutations. All of the temperate phages employed displayed a low frequency of reduction to prophage; consequently, the majority of the recipient cells were eliminated by lytic infection, reducing the chance of detecting transduced clones. Cells lysogenized with the homologous phage were therefore used in most of the experiments in order to insure survival of the recipient cells. In other experiments the phage was ultra violet-irradiated in order to reduce lytic activity when used with phage-sensitive recipient cells. Attempts were made to demonstrate transduction of fermentative characters and streptomycin resistance or independence using 10 phage strains. No evidence of transduction was obtained in experiments utilizing various combinations of 12 donor bacterial strains and 15 recipient strains.

Attempts were made to demonstrate prophage-linked transduction in S. aureus using galactose fermentation and drug resistance markers. Essentially the same procedures were employed as in the previous experiments, with the substitution of ultra violet-induced phage for the lytically-produced, phage used earlier. In order to check the effectiveness of the procedures with a known transduction system, three Escherichia coli K-12 strains (two λ-lysogenic) were used in several experiments. Prophage-linked transduction of galactose fermentation to galactose-negative strains was demonstrated and heterogenotes were isolated among the transduced clones. No evidence of a similar phenomenon in S. aureus could be demonstrated

with five of six phage strains used. One phage strain gave suggestive results; a 5 to 10-fold excess of galactose-positive clones was observed in test platings over those observed in control platings. Calculations of the t distribution, however, indicated that the results were on the borderline of significance. In addition, repeated tests consistently gave negative results.

Conversion in S. aureus was investigated by determining the effect of lysogenization of six bacterial strains on the sensitivity of the strains to 40 phage strains. Five of the six were altered in their sensitivity to one or more of the phage strains. Two of the bacterial strains were sensitive to phages with little or no activity against the parent strain, while all five were less sensitive to certain phages. In order to demonstrate that the reduced sensitivity to phage was a result of conversion rather than immunity (to homologous phage) it was necessary to prove that lysogenizing phage and excluded phage were heterologous. In one instance, it was possible to establish the heterologous nature of two such phage strains by demonstrating separate prophage sites for the phages. Phages 53 and 54 were shown to occupy different prophage sites and lysogenization with phage 53 was demonstrated to prevent lysis by phage 54. The data suggested that conversion is a common phenomenon in S. aureus.

Microfilm $2.30; Xerox $8.00. 173 pages.

THE CARBON PRECURSORS OF THE POLYNUCLEOTIDE PURINES AND PYRIMIDINES OF STAPHYLOCOCCUS AUREUS.

(L. C. Card No. Mic 59-4663)

Joseph Robert Suriano, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Stuart Mudd

The carbon precursors of the polynucleotide purines and pyrimidines have been determined for a strain of Staphylococcus aureus by the addition of C^{14}-labelled nutrients added singly to a medium of known constitution. The results were consistent with the precursors found for the purines of the pigeon, the rat, yeast, and other bacteria. Glycine, formate, and bicarbonate were found to be contributors of carbon, though only in the case of glycine were the specific activities obtained high enough to be unequivocal. Glucose, serine, and alanine also contributed carbon, presumably via a prior conversion to CO_2, "1-C" units, and glycine, though here too the specific activities were very low. As in other organisms, aspartate was found to be the principal precursor of the nucleic acid pyrimidines. Bicarbonate, glycine, and formate were also carbon contributors, though the specific activities obtained were not large enough to be unequivocal in meaning.

The strain of S. aureus studied was found to be able to utilize exogenously supplied uracil for nucleic acid uracil synthesis and was found to be able to transform it into the other polynucleotide pyrimidines. Thymine was not utilized at all. Cytosine was utilized only slightly for polynucleotide cytosine synthesis.

Exogenously available guanine and adenine could both be used for polynucleotide synthesis. However, while guanine could be converted into polynucleotide adenine, the reverse conversion took place only to a very small extent. Both purines have an effect on the incorporation of the other purine when present in greater amount. Both purines are able to depress de novo purine synthesis.

Microfilm $2.00; Xerox $3.60. 65 pages.

THE STUDY OF FACTORS AFFECTING GROWTH AND METABOLISM OF THERMOPHILIC STREPTOMYCETES.

(L. C. Card No. Mic 59-4184)

Joseph Edward Uridil, Ph.D.
Purdue University, 1959

Major Professor: Phillip A. Tetrault

The thermophilic Streptomycetes growing optimally at 60°C has remained a little known group of microorganisms. Basic investigations of the factors concerned with growth, physiology, and metabolism of these true thermophiles were undertaken. A means of ready access to the organisms was believed necessary, and a non-synthetic growth medium on which all members of the group would grow with profusion. It was thought that physical or physio-chemical factors concerned with growth should be investigated to find the environment best suited for their cultivation. A synthetic medium was deemed necessary. It was desirable to find the source of nitrogen utilized by the group as well as the sources of carbohydrate, vitamins, and necessary minerals. When the information above had been gleaned, the Warburg technique was employed to determine the carbohydrates used in metabolic pathways and the minimal essential compounds for their utilization.

A ready method of isolation was devised which makes use of a commercial preparation of colloidal silica in place of agar. Within several weeks 43 members of the group were isolated.

A non-synthetic growth medium was evolved on which all the thermophilic Streptomycetes develop rapidly and in luxurious growth. The medium consists of 15% colloidal silica, 2% powdered soy bean oil meal, 1% dextrose, 1% tryptic digest of casein, 1% sodium chloride.

Soy bean oil meal was found to sustain growth and was fractionated. A factor which was non-dializable, fairly heat stable, water soluble, alcohol precipitable, contributed to growth but was unable to support growth alone.

The physio-chemical factors investigated were osmotic pressure, acceptable between the freeze points -0.248 to -1.735, humidity effects, in which a 100% humid atmosphere was found essential for Petri plate culture, a surface tension of 40 to 49 dynes which was acceptable, and a redox potential of plus 0.19 at pH 7.1. It was learned that ether extractable substances are inhibitory whether arising from the mycelium or from growth media.

A chemically defined medium was derived which supports growth of 5 isolates chosen at random from the stock collection. The medium consists of 15 amino acids, sucrose, minerals, thiamine, biotin, and ribose nucleic acid. It was learned that these organisms utilize specific amino acids which vary with the isolate. Other sources

of nitrogen were found inappropriate. A number of rare carbohydrates were examined as sources of carbon. If RNA is included in a medium with 17 amino acids no other carbohydrate is necessary and when only essential amino acids are included, sucrose must be added to obtain a growth response. The accepted breakdown products could not substitute for the intact RNA molecule individually or collectively. Of the water soluble vitamins, only thiamine and biotin were found essential. Cultures did not grow in Brewer jars devoid of oxygen but all tested showed some development in a nitrogen atmosphere.

Warburg studies revealed that minimal essential compounds for oxygen uptake of one culture were L isoleucine, L histidine, biotin, thiamine, and minerals. Either amino acid was sufficient. Other cultures evinced an oxygen uptake with the above compounds plus a carbohydrate such as sucrose, dextrose, d-ribose, or ribose phosphate. There was cultural variation in oxygen uptake with the minimal essentials above, and some indication that essential amino acids were a limiting factor.

Microfilm $2.00; Xerox $5.40. 109 pages.

THE OCCURRENCE OF FLAGELLIN WITHIN THE CYTOPLASM OF PENICILLIN-INDUCED SPHEROPLASTS OF PROTEUS VULGARIS.

(L. C. Card No. Mic 59-4189)

David Weinstein, Ph.D.
Purdue University, 1959

Major Professors: Henry Koffler and
Merwin Moskowitz

Bacterial flagella are organized aggregates of fibrous proteins (recently named "flagellins"). When treated with acid, heat, or hydrogen bond-breaking compounds, flagella disintegrate to give flagellin solutions. Flagellins have a strong tendency to polymerize. Such polymerization within the cell may be the method for the formation of a flagellum. Evidence for the occurrence of flagellin within the cytoplasm would help reveal the site at which flagella are synthesized.

Flagella were shaken from Proteus vulgaris and were purified by differential centrifugation. Flagellin solutions were then obtained by treatment with acid. Sera against flagellin were obtained from rabbits.

Spheroplasts were obtained by the method of Lederberg (Proc. Natl. Acad. Sc., 42, 574-577, 1956). These spheroplasts could not be lysed by dilution with distilled water. On the other hand, if lactose is substituted for the sucrose used by Lederberg the resulting spheroplasts can be lysed in distilled water. In order to remove external flagella and other particulate matter, the lysed spheroplasts were centrifuged (100,000 x g, 3 hours). The supernatant liquid is referred to as the soluble fraction. No flagellin was detectable in this fraction by the Ouchterlony agar diffusion analysis probably because of the small amount present. However, even after concentration of this fraction flagellin was not detectable. Control experiments (with soluble fraction containing flagellin) indicated complete inhibition of the flagellin-antiflagellin reaction. Substances considered to be unrelated to flagellin, therefore, were removed from soluble fraction. The purification methods used were the following: 1) Heating at 60°C for 30 minutes, 2) exposure to pH 2 for 10 minutes at room temperature, 3) treatment with 2% protamine sulfate, and 4) dialysis. Control experiments (with soluble fraction containing added flagellin) indicated that 80% of the flagellin was unaffected by such treatment followed by concentration. A flagellin band was detected in the purified concentrated soluble fraction by the Ouchterlony analysis. The amount of flagellin present was determined by a semiquantitative Ouchterlony method (described below). Cells from the late logarithmic phase contained "internal" flagellin equal to 0.042-0.069% of the dry weight of the whole cells. In the course of spheroplast formation there was a five fold increase in the dry weight of the cell. Therefore the "internal" flagellin content is equal to 0.0081-0.013% of the resultant spheroplasts. Cells from the stationary phase contain "internal" flagellin equal to 0.016-0.029% of their dry weight or 0.0018-0.0032% of the dry weight of the spheroplasts since there is a nine fold increase in the dry weight during conversion of rods to spheroplasts.

An antigenic and antibody combining contaminant present in the soluble fraction had to be removed before the more precise quantitation involving the quantitative precipitin reaction could be utilized. This substance was not removed by the purification treatments. A close relation was found between this substance and the Boivin antigen. Absorption of the antiserum with this antigen removed antibodies capable of reacting with contaminants present in the soluble fraction. Quantitative precipitin studies in the test tube were then possible. By this method late logarithmic phase cells were found to contain "internal" flagellin equal to 0.044-0.049% of their dry weight or 0.0083-0.0092% of the dry weight of the spheroplasts. Cells from the stationary phase contain "internal" flagellin equal to 0.018-0.023% of their dry weight or 0.0021-0.0025% of the spheroplasts.

The semiquantitative Ouchterlony method is valuable when mixed systems are involved. Quantitation is possible on the basis of the time of appearance of lines of precipitation between serum against flagellin and flagellin at concentration of 1.0-6.0 ug N. There is approximately a one hour difference in the appearance of precipitation lines as the concentration of flagellin decreases in 1.0 ug N intervals.

The amount of external flagella of cells at two stages of growth was determined by shaking the cells and analysis of the supernatant liquids by means of the precipitin reaction. Cells in the late logarithmic phase possess external flagella equal to 0.18-0.19% of the dry weight of the whole cells. Cells in the stationary phase possess 1.15-1.20%.

Microfilm $2.00; Xerox $4.20. 79 pages.

MECHANISM OF ANTIBIOTIC ACTIVITY OF FILIPIN.

(L. C. Card No. Mic 59-4587)

Lung-Chi Wu, Ph.D.
University of Illinois, 1959

An antifungal agent, filipin, is a polyene compound which has three characteristic absorption peaks in the ultraviolet. It inhibits the growth and germination of all the fungi tested. The concentration required for inhibition of growth and germination is lower in stationary than shaken cultures.

Seventy-seven cultures of fungi were tested for their sensitivity to filipin. They can be divided into three categories: 39 cultures required 5 μg/ml. of filipin, 35 cultures required 5 to 20 μg/ml. and 3 cultures required more than 20 μg/ml. of filipin to inhibit their growth on agar plates. However, the sensitivity of fungi to filipin is not correlated to the taxonomic relationship of the fungi tested. At low concentration, filipin has fungistatic properties, e.g. Hansenula subpelliculosa remains viable after 96 hours exposure to 2 μg/ml. of filipin. On the other hand, 5 μg/ml. and 10 μg/ml. are fungicidal to the same organism. Adaptation of this organism to filipin could not be demonstrated.

When filipin was added during the lag phase, the amount required to inhibit the growth increased with time after inoculation. For cell suspensions of approximately equal optical density; the same or greater concentrations of filipin were required to inhibit cells in the lag phase as compared with cells in the stationary phase. Filipin added in the log phase at 16, 18, and 20 hours caused cessation of growth after about one hour. Cells in the log phase are considerably more sensitive to the action of filipin. At fungistatic concentration, filipin promotes mycelial growth of some yeasts, e.g. Saccharomyces cerevisiae, and Hansenula subpelliculosa. Abnormal swelling and bursting of hyphae were found on the culture of Aspergillus flavus at high concentration of filipin.

The inhibitory effect of filipin can be prevented by cholesterol and ergosterol both in solid and liquid media, however, this is not an extra-cellular inactivation for the UV spectrum and Rf value of filipin is not changed in the presence of cholesterol. Thirty one fungi were tested for the reversal of filipin by cholesterol on double gradient plates. The action of sterol was common to all fungi for cholesterol prevented the antibiotic activity of filipin in each case. When double layer for gradient plates were used; the lower layer contained 40 μg/ml of cholesterol and the upper either 20 or 40 μg/ml of filipin. The ratio of cholesterol to filipin varies with different fungi. Four species out of twelve fungi tested, i.e. Saccharomyces cerevisiae, Aspergillus flavus, Zygorhynchus moelleri, and Aspergillus sp. showed the reversal of filipin at cholesterol to filipin ratio of 1/4 and the rest of them at 1/3. Those fungi which were more easily protected by cholesterol were also less sensitive to filipin.

The reversal of filipin by high concentrations of L-cysteine and reduced glutathione was also demonstrated. Cholesterol also prevented the inhibitory effect of fungichromin as well as that of filipin, but was less effective against the activities of the other polyene antibiotics, e.g. amphotericin B and Trichomycin. Reversal of surface active agents, Hyamine and Rohm & Haas 0963, could not be demonstrated by addition of four times the concentrations of cholesterol.

An analysis of sterol contents was made on 12 fungi, but no correlation between the sterol content of fungi and the resistance to effect of filipin was found. The biosynthesis of sterols by yeast was studied in the presence of filipin. At higher levels of filipin, the per cent of total sterol and of easily extractable sterol, increased with increasing concentrations of filipin. Conversely, the per cent of total sterol decreased when lower concentrations of filipin were used. The dry weight of cells tested to decrease with increasing concentration of filipin.

The biosynthesis of protein, DNA, and RNA is not to be effected by filipin; the decrease of RNA with increasing concentrations of filipin apparently correlated with number of dead cells. Leakage from such cells brings about a reduction of dry cell weight.

The mode of action of filipin on growing cells seems to be an alteration in the nature of the cell membrane-wall complex. This conclusion is based on the observation of morphological changes and other physiological data. Microfilm $2.00; Xerox $4.20. 76 pages.

PURIFICATION OF STIMULANTS FROM CONDENSED CORN FERMENTATION SOLUBLES ACTIVE FOR LACTOBACILLUS CASEI IN MILK.

(L. C. Card No. Mic 59-4698)

Edward Alexander Zuraw, Ph.D.
North Carolina State College, 1959

Supervisor: Marvin Luther Speck

Condensed corn solubles has been shown to be stimulatory for a number of species in the family Lactobacteriaceae. The crude material, active for both L. casei and S. lactis, was dialyzed. The dialysate was chromatographed on paper which separated two active groups of stimulants. One group, termed the "immobile complex," was immobile in the solvent system used, active for only L. casei, elutable with 1 N hydrochloric acid and not studied in detail. The other group, termed the "mobile complex," was mobile in the solvent system used, active for both L. casei and S. lactis, elutable with water and studied in detail. The "mobile complex" was fractionated on Dowex - 1 which resulted in two fractions, termed fractions 3 and 4, active for both L. casei and S. lactis. Fractions 3 and 4 were individually fractionated further on Dowex - 50. Fraction 3 contained one stimulant, termed stimulant 3A; whereas, fraction 4 contained two stimulants termed stimulants 4A and 4B. At this stage of the purification procedure, the three stimulants were active for L. casei only. The relative potency of stimulants 3A, 4A and 4B were determined and found to be 45, 20 and 2 times that of condensed corn fermentation solubles, respectively. No synergism in stimulatory activity was noted when all combinations of the three stimulants were tested. The apparent contamination of the stimulants observed after paper electrophoresis and two dimensional chromatography appeared to be inversely proportional to the relative potencies.

Stimulant 3A was selected for identification and

purified further by paper chromatography and refractionation on Dowex - 50. It was identified as phenylalanine on the basis of ultraviolet absorption spectra, resistance to acid hydrolysis, paper chromatographic Rf values and color reaction of phenylalanine, quantitative amino acid analysis and biological activity.

From the above findings, it was concluded that: (1) multiple stimulants, active for L. casei in milk, are present in condensed corn fermentation solubles; (2) L. casei and S. lactis respond to different stimulants in the crude material; (3) one of the stimulants active in milk for L. casei is phenylalanine.

Microfilm $2.00; Xerox $4.40. 85 pages.

BIOGRAPHY

MATTHEW ARNOLD'S DIARIES; THE UNPUBLISHED ITEMS: A TRANSCRIPTION AND COMMENTARY

(L. C. Card No. Mic 59-4224)

William Bell Guthrie, Ph.D.
University of Virginia, 1959

This dissertation contains two main divisions. One is a transcription of the forty-four diaries Matthew Arnold kept from 1852 through 1888 (there are two diaries for each year 1875-77 and 1880-83). The other consists of headnotes, bound together in volume I for convenience, commenting upon each year's transcript and relating the materials of the diaries to his letters and to his other works.

The transcription preserves Arnold's spelling, punctuation, and grammar. It also retains his spacing of entries, his line length, and his placement of notations on the page (vertical and inverted ones are indicated). In the original copy only, entries made in pencil and those in pen-and-ink are distinguished. The transcription is a complete supplement to Lowry, Young, and Dunn's The Note-Books of Matthew Arnold; cross-references indicate where literary entries printed in their volume occur. One transcript is out of sequence. The journal which Arnold kept from March through August 1859, to supplement his Pawsey diary, was located as this project was being completed; its transcription is included in the headnote for 1859.

The biographical and other information about Matthew Arnold is organized in the headnotes as follows: his whereabouts, literary projects, finances, educational matters, reading, miscellaneous material, and school reports. The headnotes summarize the transcriptions (with some additions); they are not a substitute for them.

Two kinds of entries — school appointments and itineraries of trips — reveal Arnold's whereabouts. The former disclose his geographical movements for approximately nine months; the latter establish his location during holiday jaunts both in Great Britain and on the Continent, tours of European countries in an official capacity, and travels in America.

There are several kinds of entries of literary significance. One consists of Arnold's first draft of passages incorporated in his works. Other kinds, which help to date literary projects, consist of entries which indicate when he was composing works, mailing them to the publisher, reading and returning proof for them, and sending complimentary copies of them to friends. Another consists of Arnold's financial records, among which is a record of payments received from publishers.

A large portion of the diary entries is devoted to professional activities. For handy reference, Arnold has copied out problems and their answers to use in testing students. He also gives considerable space to facts and observations about schools jotted down as he inspects them, such as number of pupils in different standards, quality of their work, and evaluation of teachers. These served as a basis for his biennial general reports. In addition, he has noted other educational duties — the supervision of examinations and the grading of papers.

Arnold's lists of reading and quotations he copied out have been carefully checked against the published ones in Lowry, Young, and Dunn; omissions have been supplied and corrections have been made. His reading has also been correlated with his literary projects.

The miscellaneous notations record observations about the weather, addresses of friends, people to write, lists of shrubbery planted at Pains Hill Cottage, domestic trivia, and periodic resolutions to amend his daily routine. Because of the inaccessibility of Thomas Smart's Bibliography of Arnold's works, Smart's entries for 1852 forward are reproduced in this dissertation.

On the evidence of the diary entries, to which most previous writers on Arnold have not had access, errors or probable errors, particularly with regard to the dating of letters, have been corrected or questioned.

In Dryden's words, "here is God's plenty" for all Arnoldians. Access to the full diary entries, here first transcribed, would seem to be essential to any future biographer of Arnold or to any student of Arnold's life in relation to his works.

Microfilm $29.00; Xerox $104.20. 2313 pages.

THE LIFE AND TIMES OF FREDERICK EBY.

(L. C. Card No. Mic 59-4737)

James Leroy Rhodes, Ph.D.
The University of Texas, 1959

Supervisor: C. C. Colvert, Ph.D.

Frederick Eby, eminent historian and philosopher of education, has been a constructive force in Texas

education since the turn of the century. He was one of the first graduate students in education at the University of Chicago (1896-98), where he studied under Julia Bulkley and John Dewey. Becoming interested in child development, he transferred his work to Clark University (1899-1900) where he could come under the influence of G. Stanley Hall. He came to Baylor University in 1900 as Professor of Pedagogy shortly after receiving his doctorate from Clark University and, in 1909, affiliated himself with The University of Texas where he continued teaching until his retirement in 1957.

An enumeration of Professor Eby's contributions to education during his long and distinguished career would require considerable space. In the words of J. W. Edgar, Commissioner of Education for Texas, "... he is the 'father' of so many worthwhile things in our educational system in this State that it is difficult to concentrate on any individual contribution he has made." Aside from his roles as teacher, educational historian, and philosopher of education, he is the author of many books, monographs, and journal articles. Two particularly outstanding ones, both collaborated with Charles F. Arrowood, are Development of Modern Education and The History and Philosophy of Education: Ancient and Medieval. Both of these texts are widely adopted in the United States and abroad. He has just completed a volume to be entitled, Philosophy of General Education, as yet unpublished, which he expects to be his major writing.

Eby is a staunch advocate of upgrading in teacher education. He has worked toward this end during all of his career, but with particular emphasis during his long tenure (1917-1931) as director of the summer session for The University of Texas.

Professor Eby has become widely known as an innovator, promoter, and crusader for educational causes. He was the main force behind the junior college movement in Texas and is sometimes called the "father" of that movement in the State. He gave his energy and prestige to several state-wide movements which resulted in constitutional changes and legislative acts which brought educational improvement.

One of the main currents of Frederick Eby's life is that of Christian educator. He is a prominent laymen in the Baptist Church and one of his main interests has been devoted to devising ways to bridge educational and religious experience. He offered a course in Religious Education at Baylor University in 1906, perhaps the first accredited course in the nation. He devised a plan to offer religious education at the secondary level, within the framework of separation of church and state, and the plan has worked successfully in several localities.

Frederick Eby was born in Berlin, Ontario, Canada, (the town was first called Ebytown; it is now Kitchener) in 1874. His parents were members of the Mennonite faith and his forebears had belonged to the Mennonite migration from Pennsylvania toward the end of the eighteenth century. His father, a physician, practiced in nearby Sebringville. Frederick, along with his family, was converted to the Baptist faith.

He attended the village school and Stratford, Ontario, Collegiate Institute. He matriculated in McMaster University, Toronto, with the idea of becoming a Baptist minister. He later changed his plans and decided to cast his lot with education. After graduation from McMaster, he enrolled in the Graduate School of the University of Chicago.

In 1900 Frederick married Elizabeth Newman, daughter of one of his professors at McMaster, and five children were born to them.

Microfilm $3.95; Xerox $13.40. 308 pages.

BIOLOGY - GENETICS

CHROMOSOMAL HETEROGENEITY AND TUMOR-PRODUCING CAPACITY OF A MOUSE SARCOMA: ISOLATION OF FIVE SINGLE CELL CLONES IN VITRO.

(L. C. Card No. Mic 59-3900)

June Lee Biedler, Ph.D.
Cornell University Medical College, 1959

Five single cell clones (Clones I - V) were isolated by plating techniques from the Foley strain of mouse sarcoma 180 maintained in vitro. The 5 clonal lines and the parental line were analyzed and compared with respect to their chromosome constitutions and their tumor-producing capacities in vivo.

Standardized inocula of 100,000 cells were injected subcutaneously into HaICR mice. Tumors were palpable on the 4th or 5th day and were measured daily during the 3 week experimental course. The cells grew in at least 98% of the total 249 mice inoculated. The frequency of regressions varied from 43% to 92%, according to the cell line injected. Plots were made of average tumor diameters (length + width ÷ 2), and characteristic growth curves were obtained for each cell line. Clone II exhibited the greatest overall growth capacity and Clones IV and V the least, as determined from frequency of progressive tumors, rate of tumor growth, and maximum size attainment. The patterns of growth of Clones I and III approximated that of the Parent line, although the latter exhibited a greater variability between experimental groups. The growth curves of the progressive tumors were linear between approximately the 7th and the 21st days and indicated that each clonal line had a unique intrinsic growth rate in vivo. Despite an initially high rate of growth, Clone I exhibited the highest frequency of regressions, postulated as due to a greater antigenicity.

Characteristic chromosome numbers and morphology were determined for each cell line by the examination of colchicine-treated aceto-orcein squashes of metaphase cells. The cytological studies revealed that the tissue

culture strain of Foley S-180 was composed predominantly of near-tetraploid cells. The mean chromosome numbers of the clonal lines differed, as did the characteristic number and size of the metacentric chromosomes, which were present in each of the cell lines. The variance of chromosome numbers around the mean value was less in the clonal lines than in the parent line. Clones I, II, and IV were hypotetraploid, with mean numbers of 79, 78, and 73 - 74 respectively. Clone III was hypertetraploid, with a mean number of 84, whereas Clone V was hyperheptaploid to hypooctoploid, with a mean number of 147 - 151. The latter was believed to be a unique example of a near-octoploid cell line which was able to proliferate in vitro and to produce tumors in vivo.

This work has provided further evidence for the concept that some tumors consist of genetically heterogeneous cell populations. Such populations respond more readily to selective pressures, resulting in changes in morphological or behavioral properties.

Microfilm $2.00; Xerox $7.00. 150 pages.

BIOCHEMICAL STUDIES OF THREE PHENYLKETONURIC SIBLINGS PLACED ON A CONTROLLED DIET.

(L. C. Card No. Mic 59-4711)

Barbara Hyde Bowman, Ph.D.
The University of Texas, 1959

Supervisor: Dr. C. P. Oliver

Three phenylketonuric siblings were fed amino acids under controlled conditions for approximately four months. A fourth affected child received a placebo. The aim of the administration of asparagine and glutamine to phenylketonuric patients was to reduce phenylpyruvic acid formation by increasing the concentration of available amino donor, and to study what affect this would have on phenylketonuric patients. There was evidence that significant decrease in the urinary phenylpyruvic acid excretion occurred in the phenylketonuric patient who received glutamine. The decreased formation of phenylpyruvic acid due to glutamine administration in this subject was associated with an increase of alpha-ketoglutarate in the urine. No real decrease in excretion of phenylpyruvic acid was observed in the two phenylketonuric subjects receiving asparagine nor in the subject receiving the placebo.

The advantage of utilizing the total amino acids excreted as a mean of adjustment for the dilution of the urine, rather than using the creatinine level was discussed.

A slight but significant improvement in mental performance accompanied the decrease of urinary excretion of phenylpyruvic acid in the subject who received glutamine administration. A significant rise in I.Q. score was also noted in one of the two subjects who received asparagine. The other child receiving asparagine and the child receiving the placebo did not show an increase in I.Q. scores during the treatment. Although the glutamine concentrations increased in the blood of all four of the phenylketonuric subjects, the increase in the I.Q.'s did not seem to be dependent upon the amount of increase of concentration of blood glutamine in the subjects of this study. The direct cause of the increase in I.Q. scores in the two phenylketonuric subjects is unknown. The decrease of toxic products formed from phenylpyruvic acid and its derivatives may be one possible influence. One of the subjects showed a definite decrease in urinary phenylpyruvic acid. A rise of phenylalanine occurred in the blood of all four of the phenylketonuric subjects studied during the treatment. However, the rise of blood levels of phenylalanine in the phenylketonurics studied had no obvious deleterious effect on their mental performance. There occurred a rise in blood phenylalanine in both subjects whose I.Q. scores increased.

There was an increase in urinary alpha-ketoglutarate during administration of glutamine to one subject and in one of the two subjects receiving asparagine.

This study also showed that the concentration of tyrosine in the blood of six phenylketonurics tested was in the range of that found by testing sixteen non-phenylketonuric persons. The alpha-ketoglutarate levels in the urine of four phenylketonurics was shown to be higher than the concentrations found in the urine of four non-phenylketonurics.

Microfilm $2.00; Xerox $6.00. 122 pages.

THE ORIGIN OF LETHALITY IN CERTAIN SECOND CHROMOSOME RECOMBINANTS OF DROSOPHILA PERSIMILIS.

(L. C. Card No. Mic 59-4433)

Mary Rowan Capenos, Ph.D.
University of Pittsburgh, 1959

Spiess (1959) had found in Drosophila persimilis that certain individuals possessing second chromosomes of normal viability yielded recombinants whose viability was highly variable or in some cases so altered as to result in lethality. The question arose as to whether these lethal recombinants resulted from an alteration in genic interactions of linked loci (synthetic lethals) or were due to point mutations.

In the present investigation crosses involving these particular second chromosomes were repeated and the recombinants tested again to determine the potential lethal-producing characteristics of the crossover chromosomes. Lethals obtained in this manner were recombined again with a good viability chromosome in an attempt to "de-synthesize" them if they had originally resulted from recombination or to test for segregation of lethals if they were due to point mutation.

In 42 crosses strains bearing a marker chromosome and a potential lethal-producing wild chromosome were mated. Wild type F_1 females heterozygous for two wild chromosomes were out-crossed to males with a recessive marker. Ten male progeny from this cross were mated singly to double marker females; such males could possess a recombined chromosome from their mother. Heterozygous offspring (marker/recombinant) from each of these ten matings were mated to produce in the final generation, homozygous recombinants whose viability could be measured against that of their heterozygous (marker) sibs. In the ten cultures from each cross, mean viability and variance of the homozygous recombinants were determined.

Seven repeat crosses (totalling 24 lethal cultures) yielded two or more lethals. Flies balanced with a lethal chromosome and marker were crossed to a strain with a good viability chromosome. Recombination between the good chromosome and lethal chromosome could occur in F_1 females. F_2 males from this cross were tested as above and distribution of lethal cultures in final counts examined for departure (increase in viable cultures) from expected 50-50 segregation. Heterozygous F_1 males in which no recombination occurs were tested as controls.

The mean viability and variance of the repeat crosses differed little from that of original crosses, indicating a constancy in recombinational effects from the same two chromosomes.

The incidence of lethals from the repeat crosses was within values expected from mutation rate in the F_1 females and in stocks from which they were derived. Lethals were detected in two stocks which were involved in lethal production, indicating that lethals could have been carried into crosses from the stocks.

In de-synthesis crosses, the number of nonlethal cultures from heterozygous F_1 females was consistently increased, indicating a possible de-synthesis phenomenon. However, the same excess in viable cultures occurred in the F_1 male crosses. Some mechanism other than de-synthesis was probably operative. Departure from expected segregation values could result from low penetrance of the lethal, selection for nonlethal bearing gametes, or a cyto-genetic mechanism affecting normal segregation. Which of these was responsible for the excess in nonlethals could not be determined. Thus, desynthesis was not proved and lethals tested were probably mutational rather than synthetic in origin.

The present study verifies that recombination in certain second chromosomes of D. persimilis can result in viability modifications; genic interactions within these chromosomes have been altered. However, interaction is not of sufficient magnitude to produce lethality.

It has been demonstrated that second chromosome recombinants of the sibling species, D. pseudoobscura, are more highly variable in their viability modifications than D. persimilis and synthetic lethals have occurred. Since the amount of heterozygosity in the two species appears to be equal, variability in D. pseudoobscura recombinants implies a higher degree of integration. This phenomenon may explain this species' more extensive distribution and ability to inhabit a diversity of ecological situations.

Microfilm $2.00; Xerox $3.00. 44 pages.

MOLECULAR BIOLOGY OF THE TAIL STRUCTURE OF T-EVEN BACTERIOPHAGE.

(L. C. Card No. Mic 59-4128)

Sewell Preston Champe, Ph.D.
Purdue University, 1959

Major Professor: Seymour Benzer

Electron microscopy of disjoined phage components using a phosphotungstate "embedding" technique reveals considerable detail previously unobserved. The tail of the phage clearly consists of a sheath, a core, and fibers. The sheath seems to be built of helically arranged subunits which form a hollow cylinder. In agreement with other authors we have observed that the sheath can contract in length. This contraction is accompanied by an increase in diameter such that the volume of the protein is approximately conserved. The core, which is surrounded by the sheath in intact phage, is also a hollow cylinder, the hole being about 25 Å in diameter.

Tail sheaths and tail fibers have been purified from phage T2L. Sheaths have also been purified from other T-even phages.

It has been demonstrated that the head, sheath, and tail fibers of a given phage are composed of proteins with quite different amino acid sequences.

Chemical studies suggest that the sheath is composed of about 200 repeated subunits of approximately 50,000 molecular weight. No free terminal amino group could be detected for the sheath subunits. It is estimated that the head of the phage is composed of 1000 repeated subunits. Our results are consistent with a molecular weight of 80,000 for the head subunit as reported by other authors.

The corresponding proteins of different but related phages (T2L and T4B) have been compared by electrophoretic and chromatographic separations of their tryptic peptides. Corresponding proteins of these two phages were found to be quite similar, although peptide differences were detected. It appears that considerable latitude is possible in the head protein, but that the sheath protein has a relatively more restricted structure.

Evidence is presented which leads to the conclusion that the tail fibers and sheath can interact in a specific way, thereby affecting the process of adsorption to the bacterial cell. This interaction is affected by the c mutations which result in a requirement by the phage of tryptophan for adsorption. It is inferred from this that the c mutations alter a protein of either the fibers or the sheath.

Microfilm $2.00; Xerox $4.60. 87 pages.

PHYSIOLOGICAL STUDIES CONCERNING THE FORMATION OF SCLEROTIA IN ASPERGILLUS NIGER.

(L. C. Card No. Mic 59-4131)

John Henry Coats, Ph.D.
Purdue University, 1959

Major Professor: C. L. Porter

An investigation of several factors influencing the formation of sclerotia by Aspergillus niger (NRRL 346) was conducted in an effort to gain an insight into the nature of the metabolic processes involved in sclerotization. The initial research approach concerned the study of non-sclerotial mutants produced by ultraviolet irradiation. Sclerotization was induced in a moderately sporulating, non-sclerotial "black" mutant by cultivation on Czapek's medium plus a mixture of eighteen amino acids. The number of sclerotia initiated was proportional to the concentration of amino acids. Similar results were obtained when eight relatively unrelated amino acids were added individually to the medium. An investigation of $(NH_4)_2SO_4$ utilization and nitrate uptake by the mutant and parent

strains, plus studies concerning the effect of reduced nitrogen concentration on sclerotization by the latter, indicated that the black mutant was unable to utilize inorganic nitrogen readily.

A second non-sclerotial mutant, dark yellow in color, was of interest since the parent strain sclerotia were similarly colored. The yellow pigment was photosensitive in both cases, loss of color occurring rapidly in white light. Autoclaved cultures were also decolorized; however, the reversal of this reaction was accomplished only by the metabolic activity of the organism. The pigment could be extracted with several fat solvents such as ethyl ether, acetone, and methanol. The "yellow" mutant appeared to have sclerotial initials but was unable to mature sclerotia.

Spores of the black and yellow mutants seeded together produced colonies with sclerotial sectors. Anastomoses of conidial germ tubes to form a heterokaryon possessing the ability to both initiate and mature sclerotia was indicated rather than associative effects between separate mycelia.

Media dilution experiments confirmed that nutrient requirements for sclerotization are higher than for mycelial growth or asexual sporulation. Glucose concentration determined whether sclerotia formation would or would not occur; nitrate, however, controlled the number of sclerotia produced. Sclerotia size appeared to be dependent upon glucose concentration within the mycelium. Combinations of vitamins and amino acids stimulated vegetative growth and sporulation at the expense of sclerotization. This was attributed to maintenance of the available nutrient level in the mycelium below that necessary for sclerotial initiation.

Rates of glucose and nitrate uptake were determined for sclerotial, sclerotia inhibited, and non-sclerotial strains of Aspergillus niger. No significant differences were noted prior to initiation of sclerotia. It was concluded that: 1. The level of nutrients in the mycelium and not their actual utilization in initiating reactions determines whether metabolic pathways leading to sclerotia production will or will not proceed. 2. The amount of nutrients utilized in asexual sporulation is decidedly less than for maturation of sclerotia.

The efficacy of several nitrogen sources for sclerotia production was tested. $NaNO_3$, KNO_3, NH_4NO_3, and $(NH_4)_3C_6H_5O_7$ were satisfactory. With $(NH_4)_2SO_4$, NH_4Cl, and NH_4Br the pH of the medium fell to inhibitory levels. Addition of small amounts of individual amino acids to Czapek's medium produced a variety of results. Stimulation and inhibition of sclerotization, sectoring, and zonation were observed in colonies of the sclerotial strain. When alanine or methionine was substituted for $NaNO_3$ in culture medium, a fall in pH to levels inhibitory to sclerotia formation occurred.

Investigations of the effect of temperature, light, humidity, pH, and oxygen tension on sclerotization were conducted. Temperatures of 15^0 and 35^0 C. completely inhibited sclerotia production but allowed abundant sporulation. Cultivation in continuous daylight fluorescent light prevented sclerotia initiation but did not interfere with their maturation. An investigation of the action spectrum indicated that the blue region was responsible for this effect. Humidity studies prompted the conclusion that a low relative humidity inhibits sclerotization only indirectly through dehydration of the culture medium. Sclerotia were formed over an actual pH range of 3.5 to 6.8. A pH of 2.7 or lower completely inhibited sclerotization.

Sclerotia initiation did not occur when Aspergillus niger was cultivated in an atmosphere containing two per cent oxygen, obtained by diluting air with nitrogen in a vacuum desiccator. Oxygen uptake studies utilizing Mandels and Siu differential manometers indicated that oxygen consumption by a sclerotial strain prior to initiation of sclerotia was not significantly different from the amount taken up by a non-sclerotial or inhibited strain in the same time period. It was concluded that the inhibitory effect of lowered oxygen tension is due to a controlling action on metabolic pathways leading to sclerotization, rather than to insufficient oxygen for initiating reactions.

Several compounds were found during the course of the research while inhibited sclerotia formation. Of these, $Na_2S_2O_3$ and $KClO_3$ were the most specific.

It was concluded that inhibition of several different reactions, many of which may be far removed from the pathway immediately associated with the production of an initiating compound may prevent sclerotization in Aspergillus niger. Microfilm $2.00; Xerox $4.60. 88 pages.

QUANTITATIVE INHERITANCE STUDIES ON PROTEIN, TEXTURE AND YIELD IN SEGREGATING POPULATIONS OF SOFT RED WINTER WHEAT.

(L. C. Card No. Mic 59-4684)

William Hatch Davis, Ph.D.
North Carolina State College, 1959

Supervisor: Gordon Kennedy Middleton

Frondoso and Frontiera, introduced into the soft wheat breeding program for leaf rust resistance, created some unusual quality problems in protein and texture. This study was undertaken to investigate the inheritance of this source of protein, as well as texture and yield of families resulting from crosses having this source.

The study, which included four varieties crossed to make up four different populations, was conducted for two years at two locations in North Carolina in order to gather data for computing variance components, heritability estimates (in the broad sense) and correlations between the three traits. The varieties used as parents were Atlas 66 (high protein, hard texture), Leap (low protein and soft texture), Chancellor (low protein and soft texture) and Malakoff-Nittany-3 (extremely soft texture).

Heritability estimates for protein were larger in all populations than those obtained for yield and texture. They varied from 54.41 percent for the low x low protein population to a high of 68.54 percent for the high x low populations. Progress through selection was indicated in all four populations, with the Leap x Atlas 66 families expected to have the highest protein percentage, and Leap x Chancellor families the lowest.

Heritability estimates for yield varied from 14.02 percent to 52.90 percent. Sufficient genetic variability was indicated in three of the four populations for selection. In the case of families from the Malakoff-Nittany-3 x Atlas cross, however, only 2.4 percent gain was expected by selection of the top five percent of the families.

Texture showed the same fluctuations for heritability, as did yield, with estimates of 29.23 percent for the lowest and 60.22 percent for the highest estimate. The greatest

amount of progress for soft texture was predicted for the families from the Malakoff-Nittany-3 x Atlas 66 families.

The correlations (both genotypic and phenotypic) indicated a negative relationship between yield and protein in three of the four populations, but it might be possible to combine both high yield and high protein in some families. It would be easier, however, to combine high yield and low protein in families from all four populations.

Correlations (phenotypic) between yield and texture were small and non-significant in all populations, but genotypic correlations varied from + .71 to - 1.35, indicating that yield and texture have a very complex relationship existing within different populations.

Correlations, both genotypic and phenotypic, between protein and texture showed the same general trend from population to population. Relationships between these two traits varied from a positive association of hard texture and high protein to no relationship in one population and a slight negative relationship in families from the Leap x Atlas 66 cross.

All three traits were discussed with regard to family selection among the four populations.

Microfilm $2.00; Xerox $4.40. 84 pages.

RADIOBIOLOGICAL ANALYSIS OF STERILITY AND LETHALITY INDUCED WHEN ELECTROMAGNETIC IRRADIATIONS ARE AN ENVIRONMENTAL FACTOR DURING SIGNIFICANT LIFE CYCLE STAGES OF HABROBRACON JUGLANDIS (ASHMEAD).

(L. C. Card No. Mic 59-4686)

Howard Ernest Erdman, Ph.D.
North Carolina State College, 1959

Supervisor: Daniel Swartwood Grosch

As basis for a radioecological study of environments featuring ionizing radiation, sterile and lethal x-ray doses for Habrobracon juglandis (Ashmead) were found at significant developmental stages in its life cycle. The weakest link in the life cycle of this braconid wasp is the one to three-hour form in which 100 to 200r suffice as lethal. Because of parthenogenetic male production, attention was focused on females.

Appreciable doses given to the posterior pole of nine to thirteen-hour embryos made completion of development impossible. Low doses allowing normal development resulted in fertile adult females. Thus, at this stage, gonad anlagen are no more radiosensitive than somatic tissue. After the first larval instar (35-40 hours), the sterile and lethal doses diverge. Lethal doses are consistently higher. The doses progressively increase and follow the same general course; extreme divergence occurs at the 114-hour "spun-in" stage and continues as metamorphosis advances. Ninety-hour forms, spinning cocoons, are more radiosensitive compared to the preceding third and fourth instar larvae and subsequent pupae.

From cytological examination of adult ovarioles x-rayed at the developmental stages, three conclusions concerning radiopathology of the reproductive system are: (1) regardless of dose, somatic tissue functions normally to produce four ovariole sheaths, (2) radiation of larvae adversely affects the trophocytes rather than the oocyte itself, apparently the damage is chromosomal, and (3) radiation of pupae interferes with egg-nurse syncytia differentiation from oogonia.

Microfilm $2.00; Xerox $5.40. 109 pages.

THE INHERITANCE OF MESIODISTAL TOOTH DIAMETER IN TWINS.

(L. C. Card No. Mic 59-4929)

William Stuart Hunter, Ph.D.
University of Michigan, 1959

Mesiodistal tooth diameter was studied on plaster casts of the teeth of seventy pairs of like-sexed twins from the greater Detroit area, of whom thirty-seven were monozygous and thirty-three dizygous. Their average age was 16.3 years. The material was collected from 1952 to 1955 as a part of the Michigan Twin Study supported by McGregor fund of Detroit and includes, in addition to the dental casts utilized in this study, cephalograms, carpal radiographs, anthropometric, biochemical, cardiovascular, ophthalmologic, and psychological measurements. Twenty-eight teeth were measured for each twin, where possible. The purpose of the study was to determine which teeth showed the greatest influence of heredity.

All computations were made on the IBM Model 650 computer at the Statistical and Computing Laboratory of the University of Michigan, utilizing analysis of variance programs prepared by Steven G. Vandenberg for the Michigan Twin Study.

An analysis of the errors of measurement on replicate casts of twenty-three individual twins demonstrated that slight but significant differences in variability could be traced to the method of measurement and specifically, the time interval between any measures being repeated. The shorter the time interval, the more reliable was the comparison between such measures. The error study also suggested that less confidence could be placed in the measures on the first and second molars than in the measures on the other teeth.

In the consideration of missing (extracted) teeth, the monozygous twins were found to have significantly more agreement than the dizygous twins. This may be indirectly suggestive of an inherited component in factors leading to tooth loss.

The statistical comparisons of within-twin variances produced a sequence of heritability similar to the sequence of crown completion. It is therefore postulated that the size of all permanent teeth is controlled genetically to approximately the same extent, but that environment exerts a greater influence the later the tooth crown is completed. Thus, a tooth whose crown is completed at three years of age shows the influence of heredity more than a tooth whose crown is completed at six years of age.

Microfilm $2.00; Xerox $4.40. 87 pages.

FACTORS AFFECTING THE PRODUCTION OF PROTEOLYTIC ENZYMES BY SPECIES OF THE MUCORALES.

(L. C. Card No. Mic 59-4157)

William Francis Kirchoff, Ph.D.
Purdue University, 1959

Major Professor: C. L. Porter

This investigation included the following objectives: 1) To assay a representative number of species of the Mucorales for their extra cellular proteolytic activity. 2). To study the main factors affecting the production of proteases by selected species of the Mucorales.

One hundred and ten species were assayed for their proteolytic activity by the filter paper disc method on casein and gelatin agar. Forty of the tested species exhibited zones of hydrolysis of at least 15 millimeters on either of the protein substrates.

Actinomucor elegans, Cunninghamella elegans and Rhizopus arrhizus were selected for a subsequent study of factors affecting the production of proteases.

The effect of time and temperature were investigated. The optimum time was 48 hours and the optimum temperature was 32° C. for Actinomucor elegans and 35° C. for the two other test organisms. pH 7.0 was optimum for protease production in a casein-dextrose salts medium.

An easily available source of carbohydrate in addition to a nitrogen source is required for high yields of proteases. The optimum concentration of carbohydrate was 30 grams per liter.

Proteases were produced in a medium containing an inorganic source of nitrogen but yields were increased upon the addition of organic nitrogen sources. Wheat bran, casein, gelatin and Klim gave the highest yields of proteases.

Although proteolytic enzymes were produced in an essentially vitamin-free medium, the yields were increased upon the addition of various vitamins, notably pyridoxine and thiamine.

A study of the activity of the proteases, employing various activators and inhibitors, indicates that the enzymes possess essential sulfhydryl groups and do not require the tested activators for optimum activity.

The proteases do not appear to resemble any of the reported plant or animal proteolytic enzymes.

Microfilm $2.00; Xerox $4.60. 90 pages.

CYTOLOGICAL AND MORPHOLOGICAL CHANGES INDUCED IN TOMATO AS A RESULT OF THERMAL NEUTRON IRRADIATION.

(L. C. Card No. Mic 59-4161)

Charles Carroll Kuehnert, Ph.D.
Purdue University, 1959

Major Professor: Arthur T. Guard

Seeds of two species of tomato, Lycopersicon esculentum Mill. and L. pimpinellifolium Dunal, were irradiated with thermal neutrons. A lot of seeds of each species was irradiated for twenty hours and another lot was irradiated for thirty hours. When exposed to such dosages of bombardment, tomato seeds produce an ideal source of plant material for the study of radiation modification resulting from thermal neutrons.

Microscopic examination of normal apices has revealed that the apex generally exhibits a structural organization which is best interpreted according to the Tunica-Corpus concept as proposed by Schmidt (1924). Planes of cell division together with the staining reaction to safranin shows a two-layered tunica which encloses a corpus region beneath.

Examination of the apices from the irradiated series shows one or more modifications to occur. Among these modifications is a reversal of the plane of cell division occurring in the tunica region. Periclinal divisions occur in the most centrally located cells of the first tunica layer and, often, periclinal division of the cells of the second tunica layer appears to be initiated in conjunction with such divisions occurring in the first tunica layer. In other instances, planes of cell division may be so varied that the second tunica layer no longer appears as a discrete layer; thus, the corpus appears to continue unbroken from the first tunica layer. In occasional apices it has been observed that lysis of the most centrally located cells of the T-2 layer has occurred resulting in the discontinuity of that layer at this point.

Modifications of the corpus region are variable. Organization of the planes of cell division of the corpus region appear to be increasingly irregular as compared to that of normal apices.

Radiation damage resulting in earlier maturation of cells of the corpus region has been observed to occur as the result of either initiation of a loose, periderm-like tissue or as an acropetal advance of the inception of the pith rib meristem initials in closer proximity to the T-1 layer; this modification, in turn, appears to exert an influence on the general outline of the generative region, as described.

Radiation damage common to both growth zones of the apex is collapse of the cells followed by a general tissue breakdown of that area of the apex.

Thermal neutron irradiation appears to have produced some evidence that certain aspects of the Anneau Initial concept as proposed by Plantefol (1947, 1951) and his associates may be superimposed upon the tunica-corpus pattern of the tomato shoot apex. Apices, upon occasion, exhibit a staining reaction which conforms to the organizational pattern suggested by the former concept.

Dichotomous branching of the main axis, as a result of thermal neutron irradiation, is discussed. Dichotomy occurs as a result of the bifurcation of the terminal apical meristem, and appears to be associated with the abnormally occurring periclinal divisions in the first and second tunica layers. The manner in which the dichotomy may continue to develop is suggested.

Microfilm $2.00; Xerox $5.20. 105 pages.

STUDIES ON THE EFFECTS OF LIPOID EMULSIONS ON ARTERIAL INTIMAL CELLS IN TISSUE CULTURE IN RELATION TO ATHEROSCLEROSIS.

(L. C. Card No. Mic 59-3901)

Abel A. Lazzarini, Jr., M.D., Ph.D.
Cornell University Medical College, 1959

Local vascular factors play an important role in atherogenesis and a better knowledge of the cellular mechanism in lipoid absorption deposition and synthesis is necessary.

Atherosclerosis is basically a metabolic disorder of the arterial intima which appears spontaneously in man and some primates. Experimental cholesterol atherosclerosis has been an important tool in the study of this disease in animals but because of morphological and metabolic differences cannot be identified with spontaneous forms.

The studies presented here show results obtained with two new methods for the isolation and cultivation of the tunica intima from elastic or muscular normal and diseased arteries of man and animals in tissue culture.

Human and animal arterial intimal cultures show two different cell types in tissue culture: Type I, flat polygonal cells which grow as a close network with abundant cytoplasmic processes and fibrillar intercellular connections, measuring from 12 to 18 microns. Type II, spindle-shaped, bipolar cells growing in radiating strands and measuring from 60 to 75 microns in length.

No transformation of one cell type into the other was observed. Type I cells grew slower and were more susceptible to changes in the conditions of cultivation than type II cells.

To study the effects of pure lipoid microemulsions in these cells, a technique was developed for preparation of stable emulsions in water or balanced salt solutions with emulsifying agents and an average particle size of 1.5 microns or less. Several liposoluble hormones were also prepared by this method.

Preparations of cholesterol USP in balanced salt solution added at concentrations ranging from 5 to 100 micrograms per ml. were given to these cells and to control cultures. There was direct relation between concentration, incubation time and amount of intracellular deposition of Liebermann-Burchardt positive droplets.

Phagocytosis of lipoid droplets was not observed with type I cells and the mechanism of cell membrane transport of the emulsion particles is not clear, but possibly due to pinocytosis.

A saturated fatty acid (palmitic acid) in concentrations of 1 - 5 micrograms per ml. was given simultaneously with the cholesterol emulsion, increased intracellular deposition of lipoid. An unsaturated fatty acid (linoleic acid) in concentrations of 1 - 2 micrograms per ml. when given simultaneously with cholesterol emulsion inhibited intracellular lipoid deposition.

Commercial sodium heparin in concentrations of 5 - 10 micrograms per ml. given simultaneously with a cholesterol emulsion, inhibited intracellular lipoid deposition. This cytological effect seems to be independent of the heparin-clearing reaction and seems to be related to changes in cell membrane permeability.

A commercial preparation of coenzyme A of 75% purity potentiated intracellular lipoid deposition when given simultaneously with cholesterol emulsions.

Type I cells showed rapid uptake of colloidal preparations of carbon and iron saccharate particles.

The arterial intimal cells showed high succinodehydrogenase activity when tested with ditetrazolium salts. Metal chelated monotetrazolium salts showed excellent localization of formazan crystals without evidence of lipoid solubility.

It is suggested that this mechanism of cholesterol reutilization may play a role in "in vivo" atherogenesis independently of blood cholesterol levels after an initial arterial lesion is produced. This would explain clinical findings of normal cholesterol levels in cases of known atherosclerosis as temporary increase in cholesterolemia could be sufficient to initiate the lesions which would then continue their local development independent of blood values.

The functional behavior and morphology of type I cells is compatible with endothelial elements and type II cells resemble fibroblasts and histiocytes.

It is hoped that a comparative study of serum lipoids and protein fractions found in spontaneous atheroclerosis could be carried out with the methods of human intimal arterial cell cultures for further information on the complex mechanisms of lipoid absorption and synthesis at cell level.

Microfilm $2.05; Xerox $7.20. 154 pages.

AN EMPIRICAL STUDY OF THE EFFECT OF LINKAGE ON PROGRESS FROM SELECTION.

(L. C. Card No. Mic 59-4691)

Frank Garland Martin, Jr., Ph.D.
North Carolina State College, 1959

Supervisor: Columbus Clark Cockerham

An empirical approach of attacking problems in population genetics making use of high speed computers is explored. A program simulating a population evolving under mass selection has been written for the IBM 650. This program is used to evaluate empirically the effects of genetic parameters on mass selection, especially the effect of linkage in small populations.

With the aid of an electronic computer selection based on the individual's phenotype is practiced for a single character controlled by m linked genes, each having the same initial frequency. The phenotype is assumed to be the sum of a genetic effect and an environmental effect. A constant selection intensity is maintained and random mating of the selections is practiced. Selection is continued until either a predetermined number of generations has elapsed or all the parents are both homozygous and homologous. The mating of selected parents, segregation, crossing over, and environmental variates are determined stochastically with random numbers.

Results are presented for variation in population size, selection intensity, environmental variance, recombination, and number of loci. Only the completely additive model and the dominance model were considered. The initial population is considered to be a random sample

from an infinite population in linkage equilibrium. A special initial population in which every individual has the same genotype, $\frac{AbCdE}{aBcDe}$, is also considered.

It is found that with as many as twenty loci tight linkages can slow down genetic progress from selection, when the population is initially in linkage equilibrium, and cause fixation of undesirable genes in the population. The results suggest that the effect of linkage is a joint function of the number of loci, the number of individuals selected, the population size, and the recombination fraction, however it is not clear as to exactly how these parameters interact. The effect of linkage is minimized by increasing the effective population size. The results suggest that the animal and plant breeder should consider using either larger populations or select less intensely than is often found in practice, especially in those cases where many tightly linked genes are contributing to the characters under selection. Microfilm $2.00; Xerox $3.80. 70 pages.

SELECTION FOR BODY WEIGHT IN DROSOPHILA MELANOGASTER.

(L. C. Card No. Mic 59-4164)

Grady Allen Martin, Ph.D.
Purdue University, 1959

Major Professor: Audra Earl Bell

Adult body weight in Drosophila melanogaster was studied in highly inbred lines, their crosses, and a synthetic population produced by free interbreeding of the inbred lines. This trait had a heritability of 0.2 in these data with major variation due to sex, age of culture, density of population in the culture, and age at which weight was taken controlled.

Heritabilities of egg size, fecundity, and adult emergence were calculated at 0.58, 0.07, and 0.51, respectively, in the synthetic population. Estimates of genetic correlation of these traits with body weight were highly variable between samples and sources of data with values of -0.14 for egg size, 0.19 for fecundity, and 0.52 for adult emergence when data were pooled. Statistics from the random-mated population were utilized for prediction of response to inbreeding and high-low selection for body weight and for prediction of changes in the other traits during selection and inbreeding.

A replicated experiment was conducted over fifteen generations of high-low selection for body weight using a mating system that produced about three percent of inbreeding per generation. The ratio of dominance deviations to total genetic deviations was used to predict inbreeding effects on the various traits during the experiment on the assumption that heterosis and inbreeding depression are due largely to dominance gene action. Inbreeding effects were calculated in each line and generation for each trait and their means were determined. The errors of prediction ranged from -0.035 to 0.052 percent of mean fecundity, egg size, and body weight and were certainly as small and as symmetrically distributed around zero as could be expected from the use of such highly variable statistics as genetic deviations.

Selection was made on the basis of both family and individual body weights. An average of 798 flies were weighed for each line and generation. Each generation a sample was drawn from the random mating population for controls. Observed selection response was 76 percent for large size and 115 percent for small size of the predicted response. The asymmetry of response was largely due to a genetic-environmental interaction which provides a mechanism for evolutionary maintenance of static fecundity with high genetic variability in wild populations of the species. Observed divergence was 97 percent of the predicted divergence and differed by only 1.5 percent in the two replications after fifteen generations.

Response of unselected traits was poorly predicted due to variability of genetic correlation with the selected trait and to the presence of the genetic-environmental interaction. Of the net change in mean of traits, four percent for body weight, -46 percent for egg size, -156 percent for fecundity, and -32 percent for adult emergence were due to effects of inbreeding. The manifold effects of selection accounted for 96 percent, -54 percent, 56 percent, and -68 percent, respectively, of the observed net change in means of the traits. Reproductive difficulties were encountered, both as reduced family size, and as sterility of mating or failure of matings to produce live adult offspring. Where the cause of the latter could be surmised it appeared to be due to concentration of recessive lethal genes.

An accumulation of evidence for pleiotrophy of the daughterless gene for large body weight was delegated to support of major effects from closely linked gene blocks when a recombination reversed the linkage in one line.

Microfilm $2.05; Xerox $7.40. 156 pages.

ESTIMATES OF GENOTYPIC AND PHENOTYPIC VARIANCES AND COVARIANCES IN A HIGH AND A LOW YIELDING POPULATION OF FLUE-CURED TOBACCO AND THEIR IMPLICATIONS IN SELECTION.

(L. C. Card No. Mic 59-4692)

Gordhanbhai Jethabhai Patel, Ph.D.
North Carolina State College, 1959

Supervisor: Thurston Jefferson Mann

This study was undertaken with the following objectives: (1) Estimate the genotypic and phenotypic variances in a high and a low yielding population of flue-cured tobacco, (2) compare the improvement that could be made in these populations, (3) determine the optimum allocation of number of rows to a plot and optimum sample size for individual plant study.

Sixty random F_3 lines, three for each of the ten F_2 families in each of the populations (B.S. x C. 139, high in yield, and 402 x Hicks, low in yield), provided the material. This material was tested in replicated sets at the Border Belt Tobacco Research Station, Whiteville, and the Central Crops Research Station, Clayton, during 1958.

The genetic model assumed for this study was the one with additivity and dominance but no epistasis and no linkage.

In the B.S. x C. 139 population, the mean performance of parents and the relative magnitude of dominance variance to additive variance suggested non-additive (dominance type) gene action for economically important characters, cured leaf yield and quality. On the other hand, additive gene action was evidenced in general in 402 x Hicks population. The different types of gene action in these populations suggest that no single breeding procedure can be considered as the most efficient for flue-cured tobacco. A cyclic breeding procedure of selecting the superior genotypes and interbreeding them will be very efficient in the 402 x Hicks population. Whereas, in the B.S. x C. 139, a cyclic procedure of selecting desirable genotypes, inbreeding, testing and interbreeding the superior genotypes to combine favorable dominant factors, will be more efficient than the other methods. This is on the assumption that the dominance level is either partial or complete and the estimates of genetic variances represent the true gene action in the populations.

The plant-type characters in general were found to have higher heritability than yield and quality characters. Greenweight of leaf showed higher heritability than cured leaf yield.

The results on expected advance suggested that more advance can be expected in the 402 x Hicks population than the B.S. x C. 139, through several cycles of selection and interbreeding the superior genotypes. However, for improving the leaf yield, more advance can be expected in the B.S. x C. 139 than the 402 x Hicks.

There was a high correlation between plant height and cured leaf yield. It appeared to be a better selection criterion for improvement in leaf yield than flowering time and leaf number.

The high correlation between green and cured weight of leaf provides a basis to adopt greenweight of leaf as a selection criterion without material loss in efficiency. With the feasibility of testing a large number of genotypes, the greenweight of leaf may be considered even a superior selection criterion to the cured leaf weight. The loss in information on quality is the main drawback of such a selection criterion. This may be overcome by curing an adequate sample of leaves and obtaining information on the component characters that determine quality of the leaf.

In the plot technique study, the results suggested that any reduction in the number of rows without increasing the replications will reduce the precision of the experiments. As regards the size of sample for studying growth characters, a sample of two five-plant units was found to be the minimum.

Microfilm $2.00; Xerox $4.00. 73 pages.

ESTIMATES OF THE AVERAGE DEGREE OF DOMINANCE OF GENES CONTROLLING QUANTITATIVE CHARACTERS IN COTTON.

(L. C. Card No. Mic 59-4694)

Harmon Hobson Ramey, Jr., Ph.D.
North Carolina State College, 1959

Supervisor: Philip Arthur Miller

Knowledge of the general nature of the actions and interactions of genes controlling quantitative characters is important in evaluating various breeding procedures.

Each of more than 100 plants randomly chosen from the F_2 generations of each of two Upland cotton (Gossypium hirsutum L.) populations was backcrossed to both of its respective parents to produce a pair of backcross progenies. These progenies were evaluated in two environments.

Estimates of the additive genetic variance and the non-additive genetic variance for various characters were obtained in the two populations. These variances were expressed as the average degree of dominance, which, in general, was in the range of partial to complete dominance.

Substantial amounts of additive genetic variance were obtained for all the characters in both populations. This indicates that selection may be effective in improving the population mean for any character. The non-additive genetic variances were small relative to the additive genetic variances for all characters except seed cotton yield in one population. Where the non-additive genetic variances are large relative to the additive genetic variances, methods of utilizing heterosis are suggested.

Estimates of the genotype-environment interactions for the two components of the genetic variance for the various boll and fiber characters were obtained. The additive by environment interactions tended to be small compared to the additive genetic variances, whereas, the non-additive by environment interactions were larger relative to the non-additive variances. The presence of significant amounts of genotype by environment interactions indicate that material should be evaluated in a number of environments.

Correlations between the additive components of the genetic variance (r_g) and between the non-additive components (r_d) of the genetic variance were estimated for three pairs of characters in one population. Between lint yield and fiber strength, r_g was highly negative, whereas, r_d was non-significant. Between lint yield and lint percentage, r_g was highly positive and r_d was non-significant. Between lint percentage and fiber strength, r_g was negative but r_d was very highly negative. The effectiveness of selecting for two characters simultaneously can be evaluated by examining the correlation between the additive components of the genetic variation. The interpretation of the correlation between the non-additive components needs further investigation.

Microfilm $2.00; Xerox $3.00. 55 pages.

STUDIES ON THE ORIGIN OF THE NONCROSSOVER DERIVATIVES FROM THE A^b COMPLEXES IN MAIZE.

(L. C. Card No. Mic 59-4563)

Munipalli Sankaranarayana Sarma, Ph.D.
University of Illinois, 1959

Noncrossover pale cases from the $\underline{A}^b$:Peru and $\underline{A}^b$:Ecuador complexes in maize were analyzed for the presence of a separable element, β_0, the null level form of β resulting from the postulated intragenic mutation of β. Crossover stable and crossover mutable pale cases from the two sources were included in the experiment as controls. The former are known to lack the β-carrying segment while the crossover mutable α cases presumably have the $\underline{a}$:standard element at the site of β. All three classes of pale derivatives were crossed by $\underline{A}^b$ or $\underline{A}$ and the resulting $\underline{F}_1$ heterozygotes were backcrossed by $\underline{a}$. Colourless cases ($\underline{a}$*) occurring on the backcrossed ears were analyzed for their marker relations, for mutability under the influence of $\underline{Dt}_1$, and for pericarp reaction.

Recombinant $\underline{a}$* derivatives are recovered from crossover mutable α:P in very low frequencies; these $\underline{a}$* cases are mutable and show recessive or dominant brown pericarp effect. The low frequency of crossover $\underline{a}$* cases from the mutable α:P source suggests that the $\underline{a}$:standard element may not occupy the site of β. No $\underline{a}$* cases of crossover origin have been recovered from the noncrossover and the crossover stable α:P isolates. This suggests that the noncrossover α:P isolates are structurally similar to the crossover stable α:P cases and that they therefore lack the postulated β_0 element.

Colourless derivatives of crossover origin are recovered from all three classes of pale cases from $\underline{A}^b$:Ec with about equal frequencies. Whereas the $\underline{a}$* cases from the crossover stable and the noncrossover α:Ec pale cases are stable, those from the crossover mutable α:Ec are mutable. These results suggest that the noncrossover pale isolates are similar to the crossover stable α:Ec cases and that the colourless element isolated here by crossing over is not synonymous with β_0, and is situated closer to α than is β in the parental $\underline{A}^b$ complex. It is further suggested that the $\underline{a}$:standard element of mutable α:Ec may not occupy the original site of β.

Thus intragenic mutation of β to the postulated null level element β_0 does not appear to be responsible for the production of noncrossover α derivatives from either $\underline{A}^b$:P or $\underline{A}^b$:Ec.

The noncrossover $\underline{a}$* derivatives derived from mutable α sources are mutable, whereas those from the other two sources are stable. They are associated with dominant or recessive brown pericarp effect. The nature of the crossover and the noncrossover $\underline{a}$* derivatives suggests that an element designated $\underline{a}^{db}$, determining dominant brown effect, and another element designated $\underline{a}^{rb}$, associated with recessive brown pericarp, are members of the $\underline{A}^b$ complexes. The data suggest that for $\underline{A}^b$:Ec the linear order of components is centromere:α:$\underline{a}^{db}$:$\underline{a}^{rb}$:β, and that the order of elements in the $\underline{A}^b$:P complex is centromere:β:$\underline{a}^{rb}$:$\underline{a}^{db}$:α.

Microfilm $2.00; Xerox $5.00. 96 pages.

STUDIES ON A PHENYLPYRUVATE TRANSAMINASE FROM NEUROSPORA CRASSA.

(L. C. Card No. Mic 59-4742)

Robert Leon Seecof, Ph.D.
The University of Texas, 1959

Supervisor: Robert P. Wagner

A transaminase preparation was obtained from Neurospora crassa which had a specific activity about 20 times that of crude extract when assayed spectrophotometrically with phenylalanine and α-keto-β-methylvaleric acid. The preparation gave stoichiometric formation of products from these reactants. Various donor combinations were measured and ornithine, alanine and aspartate activities were found to be virtually missing in the purified preparation although present in crude extract. Quantitative measurements were made of the relative transamination rates among 19 donors. Specificity studies indicated that Neurospora amino acid transaminating activities are grouped differently than those reported in E. coli.

The behavior of the purified transaminase preparation was examined in relation to changes in pH, temperature, cofactors and substrates. Michaelis constants and maximal velocities were calculated for 7 substrates. The equilibrium constant and other kinetic constants were determined for an overall transamination reaction. The kinetic behavior of α-keto-β-methylvaleric acid was discussed in relation to the biosynthesis of isoleucine and valine.

An investigation was made of the transamination activity of Neurospora crassa, mutant strain T-77. No significant differences were observed between this strain and the control wild type strain.

Microfilm $2.00; Xerox $4.60. 90 pages.

THE RESPONSE OF COTTON TO THRIPS INJURY.

(L. C. Card No. Mic 59-4695)

Edward James Spyhalski, Ph.D.
North Carolina State College, 1959

Supervisor: Walter Joseph Mistric, Jr.

Studies on thrips affecting cotton in North Carolina were undertaken in the spring of 1956 and were completed during the fall of 1958. The research covered two major areas of study: a study of the thrips species and the magnitude of thrips population on cotton in relation to the thrips population found on wild and cultivated host plants, and a study of the response of cotton to thrips injury incurred during its seedling stage.

Injury to cotton seedlings by thrips was found to be most severe in the southernmost counties of the Southern Piedmont. Frankliniella fusca Hinds, the tobacco thrips, was the predominant species found on seedling cotton. Other species of thrips collected from cotton, but in lesser number, were Thrips tabaci Lind., F. tritici (Fitch), F. exigua Hood, and Sericothrips variabilis (Beach).

The tobacco thrips was not found in high numbers on any plants before cotton emerged. Low numbers of these

thrips were found on small grains before emergence of cotton. However, a high proportion of the total cropland in the area of the state where thrips were most severe was in small grains, especially oats. The tobacco thrips was collected from several weed plants prior to the emergence of cotton. The weeds from which the highest number of these thrips were collected and the plants which mature at approximately the time cotton is usually planted were: cranesbill, Geranium sp.; yellow wood sorrel, Oxalis stricta; wild garlic, Allium vineale; Star of Bethlehem, Ornithogalum umbellatum; wild carrot, Daucus carota; pepperweed, Lepidium virginicum; evening primrose, Oenothera sp.; and cinquefoil, Potentilla simplex.

When both soil moisture and air temperature approached the optimum for cotton growth, there was a trend toward a greater difference in plant height between thrips-infested and non-infested cotton seedlings. When either environmental factor was limiting, the plant height differences were smaller.

The effects of the severity of injury to seedlings on the growth and fruiting of cotton was studied by comparing plots, each containing cotton seedlings which had been exposed to uniform injury of one degree of severity. Plots with no injury, moderate injury, severe injury, and a mixture of moderate and severe injury to cotton seedlings were compared in a caged test where late-season insects were excluded and in a comparable test where the boll weevil, Anthonomus grandis Boh., was introduced. Blooming was retarded for two to three weeks in plots in which the seedlings were injured as compared with plots without injury. Fruiting was more intense during the first two to three weeks in plots where seedlings were uninjured than where they were injured. Total yields were significantly higher in plots without seedling injury than where seedlings were injured. When fruiting during the last half of the cotton season was reduced by a high boll weevil infestation, the increased early yield became of much greater importance.

In field tests, the percentage of cotton seedlings with severe thrips injury (terminal bud killed and all leaves injured from feeding by thrips) was generally below ten per cent. In plots without thrips-control, retarded fruiting was reflected in a yield reduction of the early one-third of the crop, when compared with plots which received insecticide applications. Total yield differences between thrips-controlled and non-controlled plots were not significant. There was no apparent difference in late-season insect attack of thrips-injured and non-injured cotton.

Microfilm $2.35; Xerox $8.20. 179 pages.

THE ROLE OF ARGININE IN THE SUBMERGED CULTURE OF MAMMALIAN CELLS.

(L. C. Card No. Mic 59-4667)

William John Thomas, Ph.D.
University of Pennsylvania, 1959

Supervisor: William F. McLimans

Conventional tissue-culture techniques require that the nutrient medium be changed at frequent intervals to maintain a state of active proliferation. This methodology presents no difficulty in the instance of the relatively small volumes handled in growing cells on a glass surface. However, it presents a major obstacle to successful and continuous cultivation of tissue cells in submerged culture, in volumes of 3 to 20 liters as commonly employed today. This report presents the results obtained when L-arginine monohydrochloride is employed as a means of circumventing the necessity for making frequent changes of medium in such submerged culture systems. This is important not only from the standpoints of economy and ease of manipulation, but also in relation to certain types of experiments wherein it is desirable to maintain, as closely as possible, a somewhat constant cellular environment.

Arginine additions have maintained cultures in a state of active proliferation up to 10 days. By using medium additions at appropriate intervals, in addition to arginine supplementation, cultures have maintained progressive growth for more than 30 days. Additionally, it has been shown that when arginine supplementation of 0.0021 mcg/ml/cell is used, inoculums as low as 2000 cells/ml may be used to initiate successful submerged cultures and cellular yields as high as 4×10^6 cells/ml may be obtained using Eagle's medium. The effect of arginine has been indicated on HeLa as well as Earle's L cell on which the majority of the work was performed.

Glucose and lactic acid determinations on submerged cultures of L and HeLa cells revealed that the addition of arginine decreased the rate of glucose utilization in L cells but apparently increased it in HeLa cultures. Lactic acid production in HeLa cells was accumulative while none occurred in actively growing L cells.

Citrulline additions have been shown to have an efficacy that is equal to the use of arginine in eliminating medium changes. However, ornithine has been ineffectual by itself or in combination with ammonia or carbamyl phosphate. Aspartic acid or urea used separately with ornithine have shown some small benefit in the maintenance of culture viability.

Microfilm $2.00; Xerox $3.00. 59 pages.

THE PROPAGATION OF MAMMALIAN CELLS IN A 20-LITER FERMENTOR AND THE APPLICATION OF LARGE-SCALE CELL CULTURE TO VIRUS PROLIFERATION.

(L. C. Card No. Mic 59-4683)

Donald Weesner Ziegler, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. W. F. McLimans

The propagation of mammalian cells in vessels of a size designed for use in fermentation pilot plant studies represents a marked departure from techniques employed in classical tissue culture studies. This study is concerned with the adaptation of several cell lines to large scale suspension culture in a twenty-liter, stainless steel fermentor, and the application of submerged cell cultures to poliovirus production.

Twenty-liter stainless steel fermentors were adapted for use in the propagation of mammalian cells in an agitated fluid suspension system. The fermentor shell of

this equipment was fabricated of type 316 stainless steel alloy, an alloy demonstrated to be non-toxic to certain mammalian cells. All service lines and accessories were constructed of stainless steel, to the complete exclusion of the usual laboratory materials. Sterilization of all components of the fermentor was accomplished by in-place steam sterilization. A culture medium composed of vitamins, amino acids, glutamine, glucose, a balanced salts-buffer system and 10 per cent animal serum was employed in cell propagation studies.

Three unrelated cell lines (strain L, a fibroblastic cell of mouse origin; strain HeLa, an epithelial-type cell isolated from a human cervical carcinoma, and strain ERK/KD, isolated from embryonic rabbit kidney) were successfully cultivated in the large stainless steel equipment. Maximum cell populations of 1.0 - 1.5 x 10^6 cells per ml were attained. It was possible to obtain three to six-fold increases with each of the cell lines during a six to twelve-day growth period.

A serially-transplantable cell line of non-primate origin, ERK/KD, supported the proliferation of poliovirus. Since the use of cell lines of primate origin is precluded because of the stigma of malignancy, the ERK/KD cell line offered a cellular host for large-scale production of poliovirus antigen. Fermentor-grown ERK/KD cells were susceptible to infection with poliovirus and permitted the virus to proliferate to a high titer. Titers of $10^{7.5}$ $TCID_{50}$ per ml were obtained upon inoculation of the cell suspension with small amounts of viral inoculum.

Studies were carried out to ascertain conditions which promoted maximum viral production and to elucidate relationships between virus production and the physiological state of the host cells. It was found that maximum poliovirus production was obtained at pH 7.5, while maintenance at lower pH values (pH 6.6) decreased virus yields. Cells maintained at pH 7.5 exhibited a glucose uptake which was three to four times greater than cells maintained at lower pH values. The effect was noted both in the case of normal, uninfected cells and virus-infected cells. Differences in pH exerted little effect upon the evolution of lactic acid by the cells. This indicated that their normal anaerobic, glycolytic rates were relatively unaffected by changes in pH of the suspending medium. Although evidence is lacking to permit the linking of viral synthesis to specific energy producing mechanisms, the results reveal that when conditions were altered in a manner which increased the total glycolytic activity of the host cells, there was a concomitant increased in poliovirus yield.

It was further demonstrated that the metabolism of infected cells was altered by the viral activity, so that the production of pyruvic acid was greatly depressed. The time of marked diminution of pyruvate production coincided with the time at which release occurred. This observation permits the period of maximum virus production to be determined without resorting to time-consuming virus titration procedures.

Microfilm $2.00; Xerox $5.20. 104 pages.

THE PHENOLOGY OF RHUS SPECIES IN WASHTENAW COUNTY, MICHIGAN.

(L. C. Card No. Mic 59-4910)

Elizabeth Florence Gilbert, Ph.D.
University of Michigan, 1959

The nature and extent of phenological variability among individuals of Rhus glabra, Rhus typhina, and intermediates between the two species was investigated in the vicinity of Ann Arbor, Michigan. Variation in phenology was associated with clonal structure and factors of the environment.

A preliminary survey indicated that there was similar phenological variation among the two species and their intermediates. A suggestion of an association was found between phenological variability and conditions of the site. A more detailed study was made during the following year on nine clones of Rhus glabra growing on one hilltop. Seven of these clones were carpellate and two staminate. Detailed information was obtained on the yearly development of one 15-year old clone.

Each clone was subdivided by topography, stem height, and exposure within the clone to form study units. Three twigs were selected at random from each subdivision, and the most rapidly developing bud was observed each day throughout the growing season. Phenological stages which were noted are: bud elongation, bud opening, leaf appearance, first flower, first fruit, and the cessation of growth in length of the twig, the leaf, and the inflorescence.

Analyses of variance showed significant difference among clones for all phenological events. In addition, certain phenological events showed significant association with some aspects of clonal structure. The sex of the clone appeared to be associated with bud elongation, bud opening, cessation of twig growth, inflorescence appearance, and first flower. The height of the stem above ground showed association with bud opening, leaf appearance, and first fruit. The age of the stem seemed to be associated with bud elongation, bud opening, leaf appearance, and cessation of leaf growth, whereas final twig length showed association with bud elongation, bud opening, leaf appearance, cessation of twig growth, inflorescence appearance and cessation of inflorescence growth.

Phenological events are grouped into the cessation events which develop slowly throughout the clone, and the developmental events which develop rapidly throughout the clone.

Through the use of a multiple range test, the mean values of all clones for each event can be grouped into those which show no statistical difference from each other. The number of times one clone is grouped with another may be considered an index of the phenological similarity of those clones.

The following conclusions can be drawn from this study: (1) The phenological variability which exists in local species of Rhus is not controlled by any one factor, though the phenological variation appears to be primarily associated with the genetic constitution of the plant. (2) The structure and life history of the plant are associated to a lesser extent with its phenology. The sex of the clone, the height of the stem above ground, the age of the stem, and the final twig length show some association with phenological events. (3) The events with which aspects of the clonal structure show association are not the same in each instance, though the opening of the bud was associated with four characters: sex, age, height, and final twig length. (4) Only the exposure of the stem within the clone and the exposure of the clone on the hilltop seem to show no association with the phenology of these sumacs. (5) The phenological responses of clones to their environment offer a means of segregating the clones into those which react similarly to similar situations. The phenological similarity of clones may be considered as an expression of the physiological and genetic similarity of the individuals and hence may be used as a measure of the relationship of individuals.

Microfilm $2.30; Xerox $8.00. 174 pages.

THE COMPARATIVE NUTRITION OF FIVE CHYTRIDIACEOUS FUNGI.

(L. C. Card No. Mic 59-4915)

Solomon Goldstein, Ph.D.
University of Michigan, 1959

The purpose of this study was to investigate the nutrition of five chytrids. The data were then used to develop synthetic nutrient media in which harvests of these fungi were obtained sufficient to make feasible future studies of their intermediary metabolism. The organisms employed in this inquiry were the monocentric fungi Rhizophydium sphaerotheca Zopf, and Phlyctochytrium punctatum Koch and the polycentric forms Cladochytrium replicatum Karling, Nowakowskiella elegans Schroeter, and Nowakowskiella ramosa Butler.

Preliminary investigations were devoted to the development of inoculation procedures the use of which would produce statistically significant results. It was noted that the utilization of zoospore suspensions as inoculum gave reproducible yields of the monocentric chytrids. Since the polycentric forms did not form sporangia when grown in nutrient media it was necessary to develop other techniques for inoculating cultures with these organisms. The use of standardized aliquots of macerated rhizomycelium was found to afford a satisfactory method of preparing inocula of these polycentric fungi. Autoclaving glucose together with the other ingredients of a tryptone-yeast extract medium did not have an adverse effect upon any of the chytrids. Aeration of liquid cultures by means of mechanical shakers resulted in more abundant yields of all the fungi with the exception of Cladochytrium replicatum. This organism, however, responded favourably to shaking when incubated in nutrient solutions devoid of yeast extract or tryptone. The monocentric forms produced their maximum growth between five and seven days after the cultures were inoculated whereas the optimum harvests of the polycentric chytrids were obtained after a sixteen day incubation period.

A study of the effect of selected physical conditions upon growth revealed that in stationary culture optimum yields of Rhizophydium sphaerotheca and Phlyctochytrium punctatum were obtained at temperatures of 30° C. and 25° C. respectively. Stationary cultures of Cladochytrium replicatum and Nowakowskiella ramosa grew best at 20° C. whereas the greatest growth of N. elegans occurred at 15° C. Light had no significant effect upon the yields of any of the fungi nor was it a factor in the synthesis of pigment by Cladochytrium replicatum. The latter organism was observed, however, to develop pigment when maintained in those aerated media which supported good growth.

The chytrids were subjected to a number of changes in their chemical environment. Media with an initial pH of 6.4 were satisfactory for their cultivation. All the chytrids were adversely affected by phosphate buffer in excess of 0.02 M. Only the monocentric forms were observed to be capable of growing under anaerobic conditions; however, all grew best when oxygen was readily available. These microorganisms were able to assimilate inorganic nitrogen although Rhizophydium sphaerotheca did not utilize nitrate to any significant extent. Of the twenty-three compounds tested glucose and mannose were the optimum sources of carbon for these fungi. With the exception of Phlyctochytrium punctatum all were dependent upon an exogenous supply of thiamin. Under the conditions of these experiments the optimum concentration of this vitamin for Cladochytrium replicatum was 50 μg. per liter of medium whereas only 10 μg. per liter of nutrient solution were necessary to ensure the maximum growth of the others.

A glucose-glutamate-thiamin synthetic medium was developed for the cultivation of Cladochytrium replicatum, Nowakowskiella elegans, and N. ramosa. This medium, devoid of thiamin, could also serve for growing Phlyctochytrium punctatum. A glucose-arginine-thiamin synthetic medium was developed for obtaining abundant yields of Rhizophydium sphaerotheca.

In general, the monocentric chytrids differed from the polycentric forms in that the former produced zoospores in nutrient solution, tended to increase the alkalinity of complex media, were able to thrive at temperatures above 25° C., and could withstand anaerobic conditions.

Microfilm $2.00; Xerox $6.00. 125 pages.

EXPERIMENTAL CONTROL STUDIES ON THE OAK WILT DISEASE.

(L. C. Card No. Mic 59-4519)

Eugene Bryson Himelick, Ph.D.
University of Illinois, 1959

An experimental program to control the oak wilt disease, caused by Ceratocystis fagacearum (Bretz) Hunt, was carried on in a forested area of northern Illinois. In this experimental forest area of 1,648 acres, over 200,000 board feet of merchantable oak timber have been killed by oak wilt in the past 13 years. This is equivalent to an

annual average loss of 6.3 per cent of the total annual production of merchantable oak timber. The timber loss was reduced in 5 years to 1.9 per cent of the annual production through the use of control practices.

Control measures were tested for 5 years to determine their effectiveness in preventing spread of the disease. The basic method followed was to provide barriers to prevent spread of the fungus through grafted roots. This was done by poisoning healthy oak trees which were within root-grafting distance of the current-year infected trees. Barriers were established around infected trees as soon as possible after the initial wilt symptoms appeared. Barriers were not placed around trees which had been killed by the oak wilt disease in previous years. To locate the diseased trees in carrying out this program, ground and aerial surveys were made each year.

Sodium arsenite, 2, 4, 5-trichlorophenoxyacetic acid (2, 4, 5-T), ammonium sulphamate (Ammate), 3-(3,4-dichlorophenyl)-1, 1-dimethylurea (CMU) were used to poison both infected and healthy trees. Trees were killed more rapidly with sodium arsenite than with the other three chemicals. Also, sodium arsenite limited fungal mat formation by the oak wilt fungus, reduced insect activity, and caused some root-kill on treated trees.

Poison barriers were established on the assumption that root-graft spread of the oak wilt fungus is related to the size of trunks and distance between diseased and healthy trees. In the 5-year program, poison barriers were placed around 571 current-year infected trees 4 inches in diameter and larger. During this period, only 12 trees became infected beyond the barrier zones and within grafting distance of poisoned healthy trees.

Where poison barriers were not established around trees killed in previous years, re-treating of some infection centers was necessary to stop further root-graft spread of the oak wilt disease. Control was obtained in 71 per cent of the infection centers in which barriers were placed around current-year infected trees. It was necessary to treat 24 per cent of the infection centers a second time and 5 per cent a third time. Approximately 92 per cent of the current-year infected trees were within 30 feet of trees previously killed by the oak wilt fungus. During 4 years of the investigation, further spread of the disease was not observed in 33 per cent of the single-tree infection centers. Only 1 per cent of all infection centers which contained five trees or less were active after 5 years. The number of years between the time that oak wilt occurred until new infection appears in individual oak wilt centers varies from 1 to 6 years.

Six chemicals were tested to determine their effectiveness in killing oak roots when applied to the soil in a limited zone about a tree. Vapam and methyl bromide killed all roots as large as 3 inches in diameter and to a depth of 3 feet. The remaining four chemicals were ineffective. No chemical injury occurred on adjacent untreated trees.

A study was conducted to determine if the oak wilt fungus could be used to eliminate unwanted oak brush in pine plantations. Over 97 per cent of the oak stems inoculated with the oak wilt fungus was killed within 2 years.

Microfilm $2.00; Xerox $4.20. 78 pages.

A PHYSIOLOGICAL STUDY OF THE EFFECT OF CERTAIN BENZAZOLES ON HIGHER PLANTS.

(L. C. Card No. Mic 59-4943)

Merle Joseph Klingensmith, Ph.D.
University of Michigan, 1959

A number of benzazoles, in particular benzimidazole, benzothiazole, and benzotriazole, were examined for their effects on growth and on water and mineral uptake of seedlings and established plants. Benzothiazole was the most active in repressing elongation of the primary root of cucumber. Benzimidazole and benzotriazole were each about one-tenth as active. Adenine was without effect in reversing the benzazole-induced inhibition of cucumber root elongation, and in fact supplemented the inhibition due to benzimidazole and benzothiazole.

The benzazoles were found to have no effect upon root respiration even after 48-hour pretreatment.

Application of benzotriazole to root medium of several genera caused a pronounced inhibition of internodal elongation with a stimulation of axillary development. Stem enlargement occurred concurrently with the suppression of internodal elongation in bushbean. In tomato and coleus plants treated with benzotriazole there were distinct morphological changes in the leaves produced after root treatment. These modifications included loss of serrations and rolling of the margins of the leaves. The above changes were unlike those produced by other growth regulators.

Application of benzimidazole to the root medium of several genera resulted in injury to the laminar tissue followed by desiccation with no concomitant effect on the stem. Application of benzothiazole to the root medium induced development of adventitious roots in several genera. This compound also caused initiation of roots on cultures of tobacco stem segments, while not suppressing bud development. It also enhanced the auxin-induced cellular enlargement of tobacco pith cultures.

Each of the benzazoles tested brought about characteristic modifications in tomato pith. These pith changes have not been observed in plants treated with any of the well known growth regulators.

The benzazoles were found to interfere with the movement of water through the plant roots of several genera. This effect was localized in the root tissue where it caused a decrease in the permeability of the root to water. Transfer of treated plants to fresh mineral solutions did not remove the inhibition due to treatment. Removal of the root permitted resumption of near-normal transpiration rate.

Benzimidazole at certain levels caused an increase in the potassium uptake of about two-fold by excised barley roots. Potassium absorption was also enhanced by treatment of roots of intact barley plants. In addition to potassium, benzimidazole also caused an increase in the uptake of calcium and sodium. This greater absorption of cations apparently took place through normal pathways and the additional increment of cation was subsequently redistributed through the plant. In contrast to the enhanced cation absorption, chloride uptake was inhibited.

The benzazoles tested seem to be of a different class of compounds from other growth regulators which have been studied. The responses elicited by treatment with each of the three benzazoles are distinctly characteristic

and are dependent on the structure of the azole portion of the molecule.

Microfilm $2.15; Xerox $7.60. 161 pages.

STRUCTURE AND DEVELOPMENT IN LYCOPODIUM LUCIDULUM MICHX.

(L. C. Card No. Mic 59-4526)

Donald Alfred Larson, Ph.D.
University of Illinois, 1959

Certain areas of the morphology and anatomy of Lycopodium lucidulum Michx. were reinvestigated. The differences in leaf form occurring in the growing season were correlated with light duration and intensity. Sporangia and bulbils normally are initiated on the undersides of decumbent stems, and their initiation and development was also correlated with light duration and intensity. In the development of the stem, progressive increase in size occurs; the vascular cylinder also becomes progressively larger and more elaborate. Dichotomization results in both reduced stem and vascular cylinder size. Subsequent growth results in increased size again. The flat apex undergoes progressive enlargement due to increase in cell number after every dichotomy. It is suggested that size of the tracheid mass is physiologically significant and may influence branching.

Tissues traditionally designated as phloem and endodermis were found to be without cells having the features now considered to be characteristic of these tissues. Pitting in the presumed phloem cells is simple and no specialized pit areas occur. Neither was callose observed though attempts at staining with aniline blue were made. This tissue has been redesignated "Conducting parenchyma." Cells of the presumed endodermis lack Casparian strips. They have thin lignified cell walls and few pits in tangential wall faces. Intercellular spaces are absent in this zone. This tissue has been redesignated as an endodermoid sheath. The tracheids of Lycopodium lucidulum have simple bordered pits. The first lignified metaxylem elements have circular bordered pits; last lignified tracheids are considerably larger and have oval and elongate bordered pits. No scalariform tracheids were observed in L. lucidulum although the tracheids of L. clavatum L., L. obscurum L., and L. complanatum var. flabelliforme Fern. have only scalariformly arranged pits.

Microfilm $2.00; Xerox $6.80. 142 pages.

SUSCEPT-PATHOGEN RELATIONSHIP BETWEEN THE ASPARAGUS PLANT AND THE RUST FUNGUS, PUCCINIA ASPARAGI.

(L. C. Card No. Mic 59-4530)

Khalil Rashid Lubani, Ph.D.
University of Illinois, 1959

The urediospore of Puccinia asparagi DC. germinates by pushing out a germ tube through one of the four pores in the cell wall of the spore. The tip of the germ tube over the stoma of the asparagus plant, Asparagus officinalis L. swells to form an appressorium which is separated from the germ tube by a septum. The appressorium produces a penetration peg which enters the stoma and swells at the distal end to form a vesicle within the substomatal cavity. The protoplasmic contents of the spore appear to move into the appressorium and thence into the penetration peg and the vesicle. Primary hyphae are produced at each end of the vesicle with septa forming between the hyphae and the vesicle. The primary hyphae grow in the intercellular spaces of the chlorenchymatous layers of the stem and produce, in turn, the haustorium-mother-cell and secondary or vegetative hyphae. The haustorium-mother-cell gives rise to a fine, peg-like growth which penetrates the cell wall of the suscept and enlarges at its distal end to form the haustorium. Urediospores are produced in the primary uredia approximately 7 days after inoculation. Teliospores then develop in these primary uredia about 15 days after inoculation, or at the time the secondary ring of uredia appears. Hyphae are intercellular and are restricted to the chlorenchymatous layers of the cortical region of the stem and in the palisade cells of the cladophyll. Suscept cells in the invaded area lose all of their protoplasmic contents and some of these cells become isolated.

Microfilm $2.00; Xerox $3.00. 36 pages.

FLORAL RELATIONSHIPS OF THE PINE FORESTS OF WESTERN DURANGO, MEXICO.

(L. C. Card No. Mic 59-4956)

James Howard Maysilles, Ph.D.
University of Michigan, 1959

The Sierra Madre Occidental is a mountain chain extending from the latitude of the Tropic of Cancer in the south of the state of Durango, Mexico, northwestward into southern Arizona. It is one of the least known regions of North America and botanical collections from the area are relatively few. The dissertation describes the forested high plateau and the barranca sections of the Sierra Madre in an area of approximately 9000 square kilometers west and southwest of Ciudad Durango. The objective of the study was to catalogue the plants indigenous to the area, paying critical attention to possible distribution patterns in the vegetation and their implications.

During four summers, 1943 collections of vascular plants, representing 579 taxa in 256 genera of 78 plant families were made. These collections were fairly complete for the season in which they were taken and represent the general character of the vegetation. The entire study area is regarded as a pine forest, but includes certain specialized habitats that support distinctive floras. Description of the extensive pine forest is followed by descriptions of the llanos in the forest, the moist barrancas cut by stream erosion, and the specialized habitat afforded by the few high peaks in the area.

In Durango, pine forest covers the extensive high plateau. The forest is rather open, and predominantly coniferous, with many species of oaks scattered among the pines. Pines govern the aspect and ecological conditions that prevail. Diversity of relief, coupled with a wide

range of geologic formations, provides many different types of habitats, including rhyolite cliffs, rich shaded ravines, open pine forest, and wet meadows. The pine forest is interpreted as a natural climax formation, occupying the higher plateau between 2500 and 3150 meters. The vegetation reflects topography, rainfall, and soils of this high plateau. The plateau seems to be an ecological tension-zone between moist barranca forest and drier grassland.

Collections from the llanos show a very strong affinity to the typical grasslands of the Mexican Plateau. In contrast to the flora of the llanos, that of the moist barrancas and optimum pine-fir forest is more complex, including a wide variety of mesophytic ferns and flowering plants not found in the llanos and ordinarily ranging widely beyond Mexico, especially in mountainous areas. This group of genera appears to be most closely related to cool-temperate floras. Associated with these are a somewhat smaller number of genera characteristic of mesophytic forest habitats in the tropics and approaching their northern limits in Durango. There also are a number of endemic species. It is clear that there is much local endemism in the grassland and in the barranca country as well. Probable new taxa, in twenty-two genera, are mentioned, but not described.

Alpine situations are lacking. The Rocky Mountain element in the flora is very small, but particularly interesting, appearing to reach its southern limit here. The floral affinities in western Durango are with the Mexican Plateau grasslands and, to a somewhat lesser extent, with montane forests both temperate and tropical. The tropical element is small but conspicuous. The major vegetational boundary, between the forested Sierra Madre Occidental of northwestern Mexico and the drier savannah and grassland of the Central Plateau of Mexico appears to be located in or near the valley of the Rio Mezquital, near the Durango-Zacatecas boundary.

Microfilm $2.35; Xerox $8.20. 177 pages.

PINE GALL RUST IN THE ROCKY MOUNTAINS.

(L. C. Card No. Mic 59-4969)

Roger Shipp Peterson, Ph.D.
University of Michigan, 1959

Western gall rust (Peridermium harknessii Moore) is a common parasite of hard pines throughout western North America. With increasing commercial use of the hosts, particularly lodgepole pine, damage caused by this fungus has become significant. This study attempts to resolve problems regarding this rust with reference to forest management in the Rocky Mountains. These problems include: (1) clearer understanding of the life cycle of gall rust; (2) working knowledge of seasonal development of the rust; (3) information regarding environmental factors which cause increase or decrease in rust populations, including factors which affect the susceptibility of pine stands to infection; and (4) analysis and evaluation of the kinds of injury caused by this pathogen.

Field investigation upon which this account is based included inoculations, phenological observations, surveys of gall-rust occurrence in relation to site factors, and dating of rust outbreaks by age-determination of galls. Laboratory work consisted of examination of herbarium collections, measurement of growth of the fungus in cross-sections from lodgepole pine stems, and study of the histology of the parasite and pathological anatomy of its hosts.

Western gall rust reportedly carries out part of its life cycle on scrophulariaceous plants, and there produces spore stages typical of the genus Cronartium. Inoculations with P. harknessii aeciospores on Castilleja in the present investigation seemed to produce only a few infections. Development of the fungus on Castilleja is described on the basis of these tests. Infection of lodgepole pine from aeciospores was obtained in addition, confirming earlier reports that this is a "pine-to-pine" rust. Aeciospores used were in part binucleate, but a majority contained amorphous nuclear material which may indicate nuclear instability. Mycelium on Castilleja was composed of binucleate cells and on pine of uninucleate cells, though both derived from aeciospore inoculation. Some field evidence indicates that in the central Rocky Mountains, infection of pine normally arises from spores produced on scrophulariaceous hosts, not from aeciospores.

In pine, gall-rust haustoria penetrate most of the cells in the cortex, phloem, cambium, and vascular rays. Aecia arise from a compact stroma which is formed in the host cortex and phloem, usually two years after infection. Dissemination of aeciospores in response to humidity changes is described. Time of spore discharge varies by locality, beginning in May or June and continuing for one or two months.

Dating the origins of rust galls reveals that only occasional years are favorable to infection of pine. Wave years may correspond to times of abundant June precipitation in the Northwest and to abundant August precipitation in the central Rocky Mountains. Pines of all ages are susceptible. However, rust outbreaks in lodgepole pine are usually limited to stands less than forty years old.

It is confirmed that the branch-gall rust is identical with the fungus causing swollen cankers on pine trunks. Cankers arise from primary galls. After their bark dies, secondary galls develop. Bark above and below the galls also dies, although it is not invaded by mycelium. Usually over twice as much xylem is produced by diseased cambium as by healthy tissue. About 32 per cent of rust-infested wood is parenchymatous, in contrast to 6 per cent of rust-free wood. The tangential growth rate of gall rust on lodgepole pine trunks is related to radial growth of the host, and can be expressed mathematically. Formulae thus derived make it possible to forecast the time of girdling of individual trees by cankers.

Gall-rust damage to pine is of two principal kinds: (1) growth losses and mortality due to branch galls, significant locally in the Northwest, and (2) cull due to trunk cankers in other Rocky Mountain areas.

Microfilm $2.00; Xerox $5.80. 116 pages.

A BOTANICAL STUDY OF EAST BATON ROUGE PARISH, LOUISIANA.

(L. C. Card No. Mic 59-4557)

Annie Louise Richardson, Ph.D.
University of Illinois, 1959

Only a few studies made on Louisiana plants are actually based on specimens. Until there are more specimens in herbaria, it will be impossible to reach a full knowledge of Louisiana's flora. This study (exclusive of grasses, sedges, and rushes) is based principally on collections which were made during a three-year period, and on a small amount of supplementary data from five herbaria. Representatives of all specimens collected are in the Herbarium of University of Illinois.

This study gives an account of 362 species distributed over 60 families. The largest family is Compositae with 38 genera and 87 species. Eupatorium is the largest genus with 11 species. Introduced or adventive species are 79 of which Leguminosae have the largest number (16). As far as I know, 236 species (65%) are here listed for the parish for the first time.

East Baton Rouge Parish is one of sixty-four parishes of Louisiana. This parish, which is bordered by three bodies of water, one of which is the Mississippi River, has an area of 451 square miles and a mean altitude of 100 feet. It is geologically young with Cretaceous limestone as its underlying bed. Physiographically, it is divided by a 20-80 foot bluff into a leveled upland and a narrow bottomland flood plain. The upland is composed of Pleistocene loess that was brought from northern glaciers by the Mississippi River. Each division has a separate drainage system: the upland is drained southeasterly by sluggish streams to the Amite River, and the southern flood plain drains southeasterly to Bayou Manchac. The subtropical winds, which accumulate moisture as they blow over the Gulf of Mexico, subject the parish to heavy rainfalls. Its semitropical climate causes a long growing season (240-269 days) in which plants are seldom subjected to droughts or frost damage.

Four vegetation regions are attributed to the parish: longleaf pine, upland hardwood, bottomland hardwood, and prairie. Tephrosia spicata, Cassia tora, Crotalaria sagittalis, Crotonopsis elliptica are some of the plants that seem to be peculiar to the longleaf pine region. Amsonia tabernaemontana, Spermacoce glabra, and Clematis crispa are in bottomland hardwood region. Upland hardwood region has Elephantopus carolinianus, Boehmeria cylindrica, Hypericum subpetiolatum, and Impatiens biflora. In the prairie region Lythrum lanceolatum, Cirsium smallii, C. horridulum, Sonchus asper, and S. oleraceus are growing.

Plant succession is most evident in the pine region. It begins with an annual grass, such as Aristida virgata, which gave way to perennial grasses, such as Andropogon virginicus and Panicum sp. These are succeeded by Cerothamnus, Ilex, and Callicarpa species, which gave in to Pinus palustris and Pinus taeda. The presence of small trees of Quercus marilandica, Q. stellata, and Q. virginiana indicate they will follow the pines.

Fossils of breadfruit, figs, and camphor indicate a previously warmer climate. Outcrops of northern species of bald cypress stumps indicate a cooler climate. Both indications correlate with geological history of the parish and suggest some pattern of succession.

Microfilm $2.55; Xerox $8.80. 194 pages.

TAXONOMY OF SETARIA (GRAMINEAE) IN NORTH AMERICA.

(L. C. Card No. Mic 59-4561)

James McDonald Rominger, Ph.D.
University of Illinois, 1959

This thesis is a monograph of the genus Setaria in North America. The species of Setaria were previously monographed by Scribner & Merrill (1900) and revised by Hitchcock (1920). An accumulation of literature during the past thirty-nine years relating to the taxonomy, morphology, cytology, anatomy, geographical distribution, and economics of Setaria has been surveyed and pertinent results incorporated into this work. This monograph is the first of Setaria to include an extensive bibliography of useful references for each binomial, detailed maps of geographical distribution, photographs of types and other authentic material, a compilation of cytological data, and a proposed phylogeny of the genus.

Setaria is represented in North America by forty-three species and four varieties segregated into three subgenera as follows: Ptychophyllum (6 spp.), Paurochaetium (10 spp.), and Setaria (27 spp. & 4 var.). Twenty-five species are native to North America, ten are range extensions from South America, and eight species are adventives from the Old World.

The treatment of each species is accompanied by a synonymy, bibliography, diagnostic description, citations of type locality, geographical range, an abridged citation of observed herbarium specimens, and a brief discussion.

Significant conclusions from this study are:

(1) Setaria vulpiseta appears to be a connecting link between subgenera Ptychophyllum and Setaria.

(2) The subgenus Paurochaetium is closely linked with subgenus Setaria by S. subtransiens at one extreme and S. ramiseta at the other.

(3) Setaria arizonica is the name proposed for a previously undescribed species from southern Arizona.

(4) Setaria adhaerans is the correct name of the tropical counterpart of S. verticillata.

(5) Setaria crus-ardeae and S. speciosa are distinct from S. poiretiana.

(6) Specimens of S. tenax with antrorsely scabrous bristles have been called antrorsa var. nov.

(7) Giant specimens of S. viridis, appearing sporadically throughout the cultivated fields of eastern and midwestern United States, are called var. major Gaudin.

(8) Setaria palmeri from southern Baja California is recognized as a distinct species within the S. macrostachya complex.

(9) Setaria leucopila merits further study to correlate morphological and chromosomal variation.

(10) Setaria geniculata represents the most highly specialized and widespread species of Setaria in the western hemisphere. Latitude of morphological variation, coupled with polyploidy, marks this species for further investigation.

Microfilm $3.50; Xerox $11.80. 270 pages.

CHEMISTRY, GENERAL

THERMOMETRIC TITRATIONS INVOLVING PROTON TRANSFER PROCESSES.

(L. C. Card No. Mic 59-5104)

William H. Dumbaugh, Jr., Ph.D.
The Pennsylvania State University, 1959

Thermometric titrations have been adapted to the study of acid-base neutralization processes in the millimolar and centimolar concentration range. Under controlled adiabatic conditions the shape of the titration curves depended primarily on the pertinent reaction enthalpies. Since comparable conventional procedures, such as potentiometric titrations, are solely a function of free energies, thermometric titrations possess signal advantages for investigation of systems with unfavorable free energy but favorable enthalpy characteristics. The purpose of the study described in this thesis was to explore the potentialities and limitations of thermometric titrations involving proton transfer processes. The overall problem was explored in terms of two discrete aspects, viz.:

(a) The applicability of thermometric titrations to quantitative analytical chemistry;

(b) The relevant thermochemical parameters and their phenomenological significance.

Using appropriate semiconductor instrumentation (thermistors) very small changes in temperature (0.005°-0.2° C) were recorded automatically during the alkalimetric titration of weak acids in dilute aqueous solutions. Corrections for extraneous heat effects were made by simple graphical extrapolation of the titration curve. Heats of neutralization at $25^{\circ} \pm 0.5^{\circ}$ C were calculated from temperature changes accessible to direct measurement on a recorder chart. A motor-driven buret coupled with a constant speed recorder provided a basis for direct calibration of the chart abcissa in terms of volume of standard titrant.

Thermometric titration curves of twenty-six monoprotic and polyprotic acids were studied critically. The applicability of thermometric titrations to the determination of weak acids in dilute aqueous solutions was investigated. The unique advantage of this method was illustrated by a comparison of typical "thermometric" and "free energy" titration curves. Four acids, whose ionization constants covered a range of nine orders of magnitude, were studied, viz. trichloroacetic ($K_i = 3 \times 10^{-1}$), monochloroacetic ($K_i = 1.6 \times 10^{-3}$), acetic ($K_i = 1.8 \times 10^{-5}$) and boric ($K_i = 6 \times 10^{-10}$). Automatic thermometric titration curves with sodium hydroxide have been recorded for each acid in a range of concentrations between 10^{-3} and 10^{-1} M. The alkalimetric thermometric titrations were precise and accurate to $\pm$ 1% for concentrations of 3×10^{-3} M and higher. At concentrations between this limiting value and 10^{-1} M, precision and accuracy were independent of concentration. Within the range of acids studied, the ionization constants had no effect on precision and accuracy because the corresponding heats of neutralization were approximately equal.

Thermometric titrations provide a simple and rapid method for determining standard heats of neutralization of acids in aqueous solution with a precision of ± 0.1 kcal/mole under virtually isothermal conditions. From the heats of neutralization, standard enthalpies and entropies of ionization were calculated for several homologous and analogous series of acids. Entropies of ionization of the haloacetic acid series exhibit a striking regularity with respect to the number of substituted halogens. An entropy increase of 6 e. u. per each halogen substitution was attributed to a unit change in the primary hydration number. The concomitant loss of degrees of freedom was postulated to be analogous to a freezing process (the molar entropy of freezing water is 6 e. u.). With the exception of succinic acid, entropies of ionization in the homologous series of saturated dicarboxylic acids were found to decrease with increasing number of carbons. Homologues corresponding to a chain length between six and nine had a constant limiting entropy of -50 e. u. A qualitative interpretation based on the inductive effect of the carboxyl ions has been offered. The fact that succinic acid does not follow this trend was attributed to internal hydrogen bonding.

Microfilm $2.00; Xerox $4.20. 79 pages.

EMISSION SPECTROCHEMICAL ANALYSIS BY THE SPARK-IN-SPRAY SOLUTION TECHNIQUE.

(L. C. Card No. Mic 59-4564)

Alvin Laverne Schalge, Ph.D.
University of Illinois, 1959

A new semi-quantitative method of analysis using the spark-in-spray solution technique has been proposed. The method has the advantage of minimizing many of the variables inherent in most emission spectrochemical procedures. Variables such as self absorption, emulsion error and the so-called matrix effect are negligible in the spark-in-spray technique. A new approach to quantitative spectrochemical analysis employing solutions has also been proposed.

The spark-in-spray emission spectrochemical technique consists of spraying the solution directly between two horizontal electrodes across which a controlled spark is applied. A spark stand and atomization system was designed and constructed featuring automatic sample lift to the atomization position and automatic return to the original position after termination of the exposure period. Such variables as atomization pressure, atomizing gas, electrode material, analytical gap width, solvents, anions and cations in the sample solution were studied to determine their importance in the spark-in-spray technique. Theoretical

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considerations have been introduced to explain some of the effects. The sensitivities of thirty-six elements were examined and compared to commonly used solution techniques.

Using the spark-in-spray semi-quantitative technique with an over-damped spark discharge, it has been possible to analyze rapidly steel, brass and silicates with errors of less than ± 30% for most elements. The method involves subjecting to analysis several dilutions of the unknown with those obtained from a known. The choice of a comparison standard has been shown not to be a critical factor in the method. Steel samples were analyzed using both steel and brass samples as comparison standards with approximately the same precision. Silicate samples were analyzed using an NBS silicate standard and a synthetic standard containing the elements of interest, but no silicon. The results obtained with the synthetic standard were as good as the results obtained with the NBS standard.

Using the results obtained from the semi-quantitative analysis, the unknown solution can be analyzed quantitatively by diluting the sample so as to make the intensity ratio of the analytical pair approach one, or some value at which the measuring error is a minimum. With this approach, aluminum, calcium, chromium, iron, magnesium, manganese, strontium, titanium and zirconium have been determined in silicates with relative average errors of 5% and coefficients of variation of 3%; synthetic standards were prepared from analytical reagent grade chemicals, and cobalt served as the internal standard element.

Calcium and magnesium have been determined in blood serum, urine, plant material and bacterial spore ash employing aluminum as the internal standard element. The determinations were considered good with relative average errors of 3 to 4%. Manganese was also determined in the bacterial spore ash at the 2-ppm level with a precision of ±6% using background radiation as the internal standard.

Microfilm $2.40; Xerox $8.40. 184 pages.

CHEMISTRY, BIOLOGICAL

THE STRUCTURAL BASIS FOR DUAL SEDIMENTATION OF THE T_2 BACTERIOPHAGE.

(L. C. Card No. Mic 59-4429)

James Leroy Allison, Ph.D.
University of Pittsburgh, 1959

The dual sedimentation of the T_2 bacteriophage of Escherichia coli B was shown to be caused by collapsible filaments attached to the tail of the particle and the phenomenon was eliminated by treating the particle with formaldehyde.

The occurrence of the reversible change of the sedimentation coefficient between the approximate values of 700 and 1000 svedbergs, as the pH of the environment is shifted above or below pH 5.8, is referred to as the dual sedimentation phenomenon. The change of sedimentation coefficient was eliminated, however, by adding formaldehyde to the virus preparation to a concentration of 2% and allowing the mixture to react for one hour before changing the pH of the nucleoprotein suspension. By this procedure the sedimentation coefficient of the 1000S component, after treatment with formaldehyde at pH 5.2 and subsequent dialysis to pH 7.0, remained constant at 1000S. Similarly the sedimentation coefficient of the 700S component, after treatment with formaldehyde at pH 7.0 and subsequent dialysis to pH 5.2, remained constant at 700S. The diffusion coefficients for the formalinized bacteriophage were measured and found to be 2.97×10^{-8} cm^2/sec for the 700S component and 3.61×10^{-8} cm^2/sec for the 1000S component, which were essentially identical to the values for the untreated bacteriophage. Formaldehyde-treated preparations were also observed with the electron microscope after dialysis against .1M ammonium acetate where the pH and the sedimentation coefficient of the material treated at pH 7.0 were 6.74 and 672S and the pH and the sedimentation coefficient of the material treated at pH 5.3 were 6.68 and 1017S. The electron microscope showed that all the bacteriophage particles treated with formaldehyde at pH 7.0 had extended tail filaments with dimensions of about 100 mμ x 5 mμ while the bacteriophage treated with formaldehyde at pH 5.3 had no tail filaments. Further investigation of the sedimentation behavior showed that, instead of being independent of the speed of the centrifuge, the sedimentation coefficient of the bacteriophage increased from five to fifteen per cent when the centrifuge speed was decreased from 12590 rpm to 800 rpm. The final aspect of the study involved sedimenting the bacteriophage at 12590 rpm against a collodion film placed diagonally across the path of sedimentation. Observation with the electron microscope did not demonstrate any preferential orientation of the T_2 bacteriophage particles that were collected on the collodion film.

Microfilm $2.00; Xerox $4.00. 71 pages.

ALKALINE DEGRADATION OF POLYSACCHARIDES.

(L. C. Card No. Mic 59-4125)

James Noble BeMiller, Ph.D.
Purdue University, 1959

Major Professor: Roy L. Whistler

To study the effect of 6-O-substitution and a C6 carboxyl group on the normal alkaline degradation reaction by the β-alkoxy carbonyl mechanism, guaran, a D-manno-D-galactoglycan, and alginates, D-mannurono-L-gulurono-glycans, have been treated with alkaline solutions. It has been shown that alkaline degradation of β-(1→4)-linked D-mannoglycans, 6-O-substituted-D-mannoglycans, and D-mannuronoglycans forms isosaccharinic-type acids by the normal β-alkoxy carbonyl mechanism.

From oxygen-free alkaline solutions of guaran at 20-80° have been isolated salts of sirupy β-D-isosaccharinic acid, $[\alpha]_D^{25}$ -1.3, and sirupy 5-O-α-D-galactopyranosyl-β-D-isosaccharinic acid, $[\alpha]_D^{25}$ +55. The structure of the modified disaccharide has been established by synthesis from methyl 2,2′-isopropylidene-β-D-isosaccharinate and 2, 3, 4, 6-tetra-O-acetyl-D-galactopyranosyl bromide by a Koenigs-Knorr reaction. 5-O-α-D-Galactopyranosyl-α-D-isosaccharino-1,4-lactone has also been synthesized.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

Indication that β-D-isosaccharinic acid is the C2 epimer of α-D-isosaccharinic acid is given by the fact that periodate oxidation affords 2.0 moles of formaldehyde per equivalent as does α-D-isosaccharino-1,4-lactone and by the fact that its nitric acid oxidation product has properties which are similar to those of the tricarboxylic acid formed by nitric acid oxidation of α-D-isosaccharinic acid.

Both esterified and ionic alginates are readily degraded by alkaline solutions at 80-120° with the formation of new 6-carbon, dicarboxylic saccharinates, 2,4-dihydroxy-2-hydroxymethylglutarates. The equivalent weight and the fact that periodate oxidation yields 0.5 mole of formaldehyde per equivalent is given as evidence for this structure.

The structure of sirupy D-2,4-dihydroxy-2-hydroxymethylglutaric acid, $[\alpha]_D^{25}$ +3.0, has been assigned on the basis that this acid gives a nitric acid oxidation product which is similar in properties to those of D-2-carboxy-2,4-dihydroxyglutaric acid obtained by the nitric acid oxidation of α-D-isosaccharino-1,4-lactone.

The structure of sirupy L-2,4-dihydroxy-2-hydroxymethylglutaric acid, $[\alpha]_D^{25}$ +5.6, has been assigned to that component whose nitric acid oxidation product has a rotation which is opposite that of D-2-carboxy-2,4-dihydroxyglutaric acid. Microfilm $2.00; Xerox $3.00. 40 pages.

THE NATURE AND FUNGITOXICITY OF AMINO ACID ADDITION PRODUCTS OF CAFFEIC AND CHLOROGENIC ACID.

(L. C. Card No. Mic 59-4130)

Richard Sargent Clark, Ph.D.
Purdue University, 1959

Major Professor: Dr. F. W. Quackenbush

Chlorogenic acid served as a growth stimulating rather than growth inhibiting factor of Helminthosporum carbonum when fed with inorganic ions plus sucrose. These same inorganic ions when added to potato dextrose broth did not reverse the inhibition by chlorogenic acid.

The effect of pH on inhibition was studied. Caffeic acid also became stimulatory with an inorganic medium at pH 6.0 to 8.0, while at lower pH ranges it was inhibitory.

A study was made of pH optima for the enzymatic formation of a cysteine-chlorogenic acid and cysteine-caffeic acid addition compound. This compound did not inhibit the growth of H. carbonum.

A hitherto unrecognized compound was discovered. It possessed greater ability to inhibit H. carbonum than either chlorogenic or caffeic acids. Upon standing at room temperature, this compound broke down to yield chlorogenic and/or caffeic acid plus eight ninhydrin reactive compounds. Six of these compounds were identified as methionine, valine, isoleucine, phenylalanine, tryptophan and tyrosine. The other two were not identified.

Possible structure of this compound and additional functions are discussed.

Microfilm $2.00; Xerox $3.00. 55 pages.

THE METABOLISM OF SOME FREE AMINO ACIDS IN DDT-POISONED PERIPLANETA AMERICANA L.

(L. C. Card No. Mic 59-4503)

John Joseph Corrigan, Ph.D.
University of Illinois, 1959

The major amino acids were quantitatively compared in hemolymph from DDT-poisoned, DDT-treated but symptom free, and untreated American cockroaches. Symptoms were induced by holding DDT-treated insects at a lower temperature in accordance with the negative temperature coefficient of action of DDT. While the concentrations of most amino acids were unchanged, free proline was depleted in the blood of insects showing symptoms. This depletion was rapid and progressed as the duration of symptoms increased. After four or five hours of symptoms, the level of blood proline was approximately one-fourth that found in blood from either symptom-free insects or normal insects which had not received DDT.

Relief of DDT symptoms following transfer of prostrated cockroaches to a higher temperature resulted in a restoration of proline to the normal level in the hemolymph (0.4 to 0.6 mg. per ml.). Reprostration of insects allowed to recover from symptoms again resulted in the depletion of proline.

Experiments with TDE on the tobacco hornworm, Protoparce sexta, and DDT on the house fly, Musca domestica, gave similar results. Treatment of cockroaches with pyrethrum and lindane resulted in slight decreases in blood proline, while dieldrin and TEPP produced no changes. Cockroaches subjected to electrical shock or physical agitation showed no changes in the level of blood proline.

Randomly labeled L-proline-C^{14} was injected into DDT-treated cockroaches in order to follow the distribution of proline carbons during the depletion process. Insects were held two-and-a-half hours and four hours after injection; then the blood was collected and the insects dissected. The $C^{14}O_2$ from insects with symptoms was about three times higher in specific activity than that from symptom-free insects, although both poisoned and control cockroaches oxidized large amounts (20 to 50%) of the injected dose.

The blood and all the tissues were fractionated into water-soluble, lipid-soluble and protein fractions, which were radiometrically counted for total C^{14}. Chromatograms of water extracts of blood, nerve tissue, muscle, and fat body revealed that proline-C^{14} was readily converted by all insects into glutamic acid-C^{14} and glutamine-C^{14}. In the insects with symptoms, proline-C^{14} was depleted in blood, muscle and, to a lesser extent, in nerve tissue, while an increase was observed in fat body. Glutamine-C^{14} increased about four fold in the blood and nerve of poisoned insects, and in general glutamic acid remained unchanged.

It was concluded that two mechanisms were responsible for the depletion of proline. One was a respiratory demand for substrate supplied by the oxidative deamination of glutamate to alpha-ketoglutarate, proline being utilized to maintain the level of glutamic acid. The other was the increased synthesis of glutamine from glutamate in the blood and nerve of poisoned insects.

Microfilm $2.00; Xerox $4.60. 88 pages.

PHYTOSYNTHESIS OF THE LIPIDS.

(L. C. Card No. Mic 59-5106)

Richard Alan Ferrari, Ph.D.
The Pennsylvania State University, 1959

The purpose of this investigation was to study the biosynthesis and metabolic interrelationships of the lipids during steady state photosynthesis by the alga Chlorella pyrenoidosa in the presence of $C^{14}O_2$.

Total lipid extracts from fifteen second through six hour C^{14}-labelling experiments were quantitatively deacylated by methanolic potassium hydroxide at room temperature and subjected to separation by two-dimensional paper chromatography. Galactosyl monoglyceride was the lipid synthesized most rapidly, followed by digalactosyl monoglyceride, phosphatidyl glycerol, galactose sulfate monoglyceride, phosphatidyl inositol, lecithin, and phosphatidyl ethanolamine in that order. An analysis of kinetic curves demonstrated that galactosyl monoglyceride may be a precursor of the digalactoside lipid. Also, phosphatidyl glycerol may be a precursor of inositol phosphatide, which in turn, may serve as a precursor for lecithin and phosphatidyl ethanolamine biosynthesis.

Periodate oxidation of diglycerol phosphate from phosphatidyl glycerol showed that the former became apparently uniformly labelled within five minutes of photosynthesis. Acid hydrolysis of glycerylgalactoside from galactosyl monoglyceride revealed that, during short photosynthetic exposures to $C^{14}O_2$, the galactose moiety exhibited a higher rate of C^{14} incorporation than the glycerol.

Separation of intact lipids on silicic acid-impregnated paper followed by basic hydrolysis of the resultant spots showed that, by six hours of photosynthesis, the fatty acids associated with triglycerides were the least uniformly labelled of any of the lipids investigated. The fatty acids esterified to galactosyl glycerol and diglycerol phosphate contained the greatest C^{14} activity, which is consistent with the metabolic activity of the free polyols. Triglyceride biosynthesis, therefore, probably progresses at a rate slower than that for the phosphatides and galactolipids.

The steady state concentrations of the various lipids were determined to serve as a basis of comparison with their rate of C^{14} incorporation. Phosphatides, as determined by neutron activation chromatography, were 1.4×10^{-3} M. Galactolipids, by calculation, represented more than twice the amount of phospholipids present. The molarities of galactosyl monoglyceride and digalactosyl monoglyceride were 2.5×10^{-2} M and 1.0×10^{-2} M, respectively.

This study emphasized the metabolic importance of the galactolipids, long overlooked major constituents of plant cells. Microfilm $2.00; Xerox $3.80. 69 pages.

SOME BIOCHEMICAL AND PHYSICAL CONSIDERATIONS RELATING STRUCTURE TO PLANT GROWTH REGULATING ACTIVITY OF N-ARYL CARBAMATES, SUBSTITUTED UREAS AND CHLOROPHENOXYACETIC ACIDS.

(L. C. Card No. Mic 59-4311)

Virgil Haven Freed, Ph.D.
University of Oregon, 1959

Adviser: Francis J. Reithel

The work presented in this thesis is concerned with the relation of structure to activity and the mode of action of three different groups of plant growth regulators. The chemicals used in the investigation were mono-, di-, and tri substituted chlorophenoxyacetic acids, O-alkyl N-aryl carbamates and 3 aryl 1 alkyl substituted ureas.

The plant growth regulating activity of a number of compounds of each group was determined. It was found that the activity varied markedly with structure and physical properties. In general, the position of substituent groups on the aromatic rings appeared to have greater influence on activity than did the nature of the group. Substitution in the 4 position was found to influence the growth regulating of the phenoxyacetic acids and substituted ureas more than any other position. In contrast the greatest activity in the carbamate series was found when the substitution occurred in the three position. Many of the members of all three series of compounds demonstrated measurable growth regulating activity.

The infrared absorption spectra of the chlorophenoxy acetic acid series was measured. It was found that infrared absorption in the region of 12 microns correlated well with the biological activity of these compounds.

It was felt that an understanding of the relation of structure to activity requires a knowledge of the mode of action of these chemicals. Studies were conducted to ascertain the manner in which these growth regulating chemicals act. All three groups were found to influence both nitrogen and carbohydrate metabolism. Respiration of tissue slices and oxygen uptake by mitochondria were inhibited by representative members of each group. The inhibition of the enzymes of the Krebs cycle by 2,4-dichlorophenoxyacetic acid (2,4-D) was found to be of a general rather than a specific nature. Study of the Lineweaver-Burke plots of the data revealed that the inhibition was not competitive.

The inhibition of oxygen uptake was found to be reversible in that removal of the 2,4-D resulted in recovery of oxidative activity. Measurement of this inhibition at two different temperatures revealed a negative temperature coefficient. Similarly determination of the inhibition of seedling growth at two different temperatures indicated that a high "entropy" change accompanies the action of these chemicals.

The data presented in the study were interpreted as indicating that adsorption on proteins is the primary event in the action of growth regulators. Other data indicate that the structure of the protein is modified as a consequence of the adsorption of the chemical. This will be reflected in a change in the enzymatic activity of the protein. The hypothesis is advanced that adsorption of the chemical on a protein surface and subsequent change of the proteins enzymatic activity is the means by which growth regulators act.

The foregoing hypothesis is used to explain the fact that the chemicals can stimulate growth or inhibit it depending upon concentration. Similarly the relation of structure to activity becomes more understandable in terms of adsorption. Microfilm $2.00; Xerox $6.60. 137 pages.

PYRIMIDINE NUCLEOSIDE METABOLISM AND ANTIMETABOLITES.

(L. C. Card No. Mic 59-3518)

T. Kay Fukuhara, Ph.D.
University of Southern California, 1959

Chairman: Professor Visser

New derivatives of cytidine have been prepared. They are 5-chlorocytidine, 5-chlorocytidine triacetate, 5-bromocytidine, 5-bromocytidine triacetate, 5-aminocytidine sulfate, and a derivative (possibly a hydrate) of 5-hydroxycytidine. Chlorocytidine, bromocytidine, and aminocytidine sulfate inhibit the growth of a pyrimidine-requiring mutant mold, Neurospora 1298. The degree of inhibition is greater when cytidine rather than uridine is supplied as the obligatory growth supplement. The 5-hydroxycytidine derivative is less active than 5-hydroxyuridine in the above system. Aminocytidine sulfate inhibits growth of wild-type Neurospora, whereas the halocytidines were inactive. Chlorocytidine and bromocytidine inhibit the growth of Neurospora 1298 and in vitro propagation of Theiler's GD VII virus to a greater extent than chlorouridine and bromouridine. However, aminouridine and hydroxyuridine are better inhibitors of wild-type Neurospora and certain rodent tumors than the corresponding cytidine derivatives.

It has been shown by other investigators that C^{14}-cytidine is utilized for ribonucleic acid (RNA) and deoxynucleic acid (DNA) pyrimidine synthesis to a greater extent than C^{14}-uridine. Inhibition studies using Neurospora 1298 have shown that uridine analogues depressed competitively the mold growth promoted with cytidine more readily than that produced with uridine. In consideration of these findings, it seemed reasonable to expect that analogues of cytidine might interfere with nucleic acid metabolism more effectively than uridine analogues. Thus, 5-substituted cytidines were synthesized to investigate this possibility.

Halogenation procedures previously described for the preparation of 5-halouridine compounds were not effective for synthesis of 5-halocytidines. Ultraviolet light activation of cytidine in a solution of anhydrous pyridine, acetic acid, and halogen was found to be essential for halogenation of the nucleoside. Halocytidine triacetate was isolated as an intermediate in the above process, and alkaline hydrolysis of the ester yielded halocytidines. Aminocytidine was obtained by aminolysis of bromocytidine and crystallized as the sulfate.

Hydroxycytidine was prepared from a bromoderivative of cytidine in the following manner. A solution of brominated cytidine was formed by treating an aqueous solution with a slight excess of bromine. The solution was passed through a column of anion-exchange resin, IRA-4B(OH^-). Upon lyophilization of the effluent wash and crystallization of the residue, needles of hydroxycytidine containing one molecule of water were obtained.

A method for preparing 5,6-dihydrocytidylic acid by electrolytic reduction of cytidine-2′ and 3′-phosphate in an alkaline medium was developed. Since extensive conversion of C^{14}-cytidine to dihydrocytidine-5′-phosphate in liver slices had been reported, the metabolic role of reduced pyrimidine nucleotides was investigated in vivo. The C^{14}-labeled 5,6-dihydrocytidine-2′ and 3′-phosphate prepared as above and C^{14}-labeled 5,6-dihydrouridine-2′ and 3′-phosphate were injected separately into rats, and the extent of incorporation of the radioactive dihydropyrimidine nucleotides in various tissues was determined. The reduced pyrimidine nucleotides were not utilized for RNA and DNA synthesis, and extensive dephosphorylation of reduced uridine-2′ and 3′-phosphate to 5,6-dihydrouridine occurred.

A tracer study using C^{14}-ureidosuccinate as a precursor of nucleic acid pyrimidines was performed to determine whether infection with Theiler's GD VII encephalomyelitis virus produced changes in the rate of RNA pyrimidine synthesis in six-week-old mouse brains. Non-virus-infected and virus-infected brains of mice were given intracranial injections and incubated in situ with C^{14}-ureidosuccinate. The pyrimidine nucleotides were isolated from the acid-insoluble RNA fraction and separated by ion-exchange chromatography. Radioactivity determination of the eluate fractions showed that uridylic-5′-acid contained twenty times more counts than cytidylic-5′-acid. However, no significant differences in C^{14} activity were found in the nucleotides isolated from noninfected and infected brains.
Microfilm $2.00; Xerox $5.60. 112 pages.

ISOLATION AND MOLECULAR PROPERTIES OF RAT LIVER MALIC DEHYDROGENASE.

(L. C. Card No. Mic 59-4513)

Forrest Craver Grimm, Ph.D.
University of Illinois, 1959

Malic dehydrogenase (MDH) from rat liver has been purified about 1500-fold in an over-all yield of 10-15%. This procedure departs from that used for pig heart malic dehydrogenase by Straub (Straub, F. B., Z. physiol. Chem., 275, 63, 1942) and involves heat treatment in the presence of substrate, ethanol fractionation, ion exchange chromatography, and zone electrophoresis on starch. The first three steps have previously been described by Huang (Huang, T., Ph.D. Thesis, University of Illinois, 1958), and the present thesis reports the use of starch zone electrophoresis as the final purification step and some molecular properties of the malic dehydrogenase thus obtained.

The following steps are involved in the purification procedure: (1) homogenization of rat liver in 0.03 M NaCl-0.005 M ethylenediaminetetraacetate, pH 6; (2) heat treatment at 58-59°C. for one minute in the presence of 0.05 M sodium malate, pH 6.8; (3) ethanol fractionation, 40-60% by volume; (4) adsorption of the enzyme on Amberlite IRC-50 (XE-64) from 0.02 M sodium citrate buffer, pH 6.25, and gradient elution with 0.1 M sodium citrate, pH 6.05; (5) starch paste zone electrophoresis in 0.05 M sodium citrate, pH 5.4, for 24 hours. By these steps about 9 mg. of 1500-fold purified

malic dehydrogenase were obtained from 350 grams of frozen rat liver.

Malic dehydrogenase obtained in this manner gave a single boundary in sedimentation velocity experiments and was 80-90% pure in moving boundary electrophoresis. The best preparations had measurable glutamicoxalacetic transaminase activity. The absorption spectrum showed only the 280 mμ peak characteristic of proteins. Zone electrophoresis on starch has indicated that the isoelectric point of malic dehydrogenase is near pH 6.3. At about 1% protein concentration the diffusion coefficient ($D_{20,w}$) was found to be 5.21×10^{-7} cm.^{2}/sec. while the sedimentation coefficient ($S_{20,w}$) was 4.15×10^{-13} sec. With an assumed partial specific volume of 0.75 cc./gm. these values give a molecular weight of 80,000 which agrees closely with the values obtained from the sedimentation equilibrium method of Archibald. The molar frictional ratio was calculated to be 1.36, thus indicating that nonspherical particles were involved under the conditions used for the molecular weight studies.

Intracellular enzyme distribution studies were made by differential centrifugation, and it was found that the MDH isolated and characterized above was located in the mitochondria. Zone electrophoresis and ion exchange chromatography revealed another form of malic dehydrogenase, with an isoelectric point below pH 5.4, which was found only in the supernatant cellular fraction. This "supernatant" MDH represented about 1/3 to 1/4 of the malic dehydrogenase found in rat liver cells. Separation of these two MDH forms by ion exchange chromatography eliminates the need for tedious differential centrifugation prior to purification of the forms. The "supernatant" form has not yet been isolated and characterized.

Microfilm $2.00; Xerox $3.80. 68 pages.

THE CYANOGEN CHLORIDE METHOD FOR RESIDUAL CHLORINE DETERMINATIONS IN WASTES.

(L. C. Card No. Mic 59-3583)

Stanley E. Katz, Ph.D.
Rutgers University, 1959

Major Professor: H. Heukelekian

The cyanogen chloride method for measuring residual chlorine concentrations in wastes involves the reaction between residual chlorine and cyanide to form cyanogen chloride. The cyanogen chloride is determined by its reaction with pyridine and an aromatic amine to form a color, the intensity of which is proportional to the original concentration of residual chlorine. The color intensity is measured spectrophotometrically. This reaction is specific for free halogen and compounds containing available halogens. As chlorine is the halogen most commonly used for disinfection, the method can be considered specific for chlorine.

Variables such as ph, temperature, stability of color, effect of ions were studied. Calibration curves were established for three types of colorimeters. The cyanogen chloride, o-tolidine, amperometric, and starch-iodide methods were compared in water. The results showed no significant difference between methods in water. The cyanogen chloride and amperometric methods were compared in wastes. A wide variance in results occurred in the wastes used.

The final criterion of any analytical method for residual chlorine is the manner in which it correlates with the numbers of coliform organisms remaining.

The cyanogen chloride and amperometric methods were compared with the numbers of coliforms remaining in two primary effluents, one secondary effluent and a highly industrial trunk sewer wastes. In the two primary effluents and the secondary effluent, the cyanogen chloride method had slightly greater coefficients of determination than the amperometric method. However, when compared on the basis of the 95 per cent confidence limits, these differences did not prove to be statistically significant.

In a sewage containing a larger proportion of industrial wastes, the amperometric method had a higher coefficient of determination than the cyanogen chloride method. On the basis of 95 per cent confidence limits, the difference between the methods was not statistically significant.

It was concluded that the amperometric and cyanogen chloride methods were practically equal in value as indices of disinfection. Microfilm $2.00; Xerox $7.20. 151 pages.

STUDIES ON AN INOSITOL PHOSPHATIDE FRACTION OBTAINED FROM GREEN PEAS.

(L. C. Card No. Mic 59-5309)

Lawrence Martin Lewin, Ph.D.
Cornell University, 1959

This study was conducted in order to determine the conditions necessary to liberate an inositol-phosphatide-rich fraction from green peas (Pisum sativum) and to investigate the properties and composition of this fraction.

The method of extraction of inositol phosphatide fraction was a small-scale modification of the method used by Wagenknecht (1957). In this method, the acetone-insoluble lipide (the phosphatide fraction) of peas was extracted with glacial acetic acid. The insoluble residue was partitioned between aqueous acetic acid and benzene. The benzene-soluble fraction was lyophilized. This lyophilized material appeared to contain the mixed calcium and magnesium salt of inositol phosphatide.

Several variables were investigated to determine their effects on inositol phosphatide yield. Green peas did not appear to yield inositol phosphatide fraction if they were quick-frozen immediately after harvest and were then immediately lyophilized and extracted. It was noted that inositol phosphatide fractions were obtained in good yield from peas of Thomas Laxton, Perfected Freezer, and Pluperfect varieties of all stages of maturity from extremely small peas, through the edible stages, up to but excluding dry seed peas, providing that the peas were placed in frozen storage (-17.8°C) while raw and were held at this temperature for from several days to several months before they were lyophilized and extracted. Dry seed peas yielded extremely small amounts of inositol phosphatide.

The effect of heat treatment (60 seconds in boiling water) of the peas before they were placed in frozen storage was investigated. It was noted that peas which had

been heat-treated to destroy enzyme activity did not yield appreciable amounts of inositol phosphatide fraction after intervals of several months in frozen storage.

The above facts support the hypothesis that the components of the inositol phosphatide fraction are liberated enzymatically during raw frozen storage of peas. Diastase and emulsin enzyme preparations were incubated with slurries of blanched peas. These experiments failed to produce an increased amount of inositol phosphatide, thus failing to substantiate (or disprove) the theory that the inositol phosphatide precursors are linked through glycosidic bonds to the inositol moiety.

The inositol phosphatide fraction from peas of Thomas Laxton variety was partially purified by formation of the colloidal potassium salt and dialysis of the latter against distilled water. The dialyzed potassium salt was further purified by silicic acid column chromatography, using the method of Hanahan and Olley (1958). By this means, the inositol phosphatide fraction was shown to be nonhomogeneous although it produced an effluent peak in the region in which Hanahan and Olley obtained their monophosphoinositide fraction. Chromatography on silicic-acid-impregnated paper by the method of Marinetti et al (1957) also showed evidence for the presence of inositol lipide.

The properties and composition of the inositol phosphatide fraction have been studied. Infrared and ultraviolet spectra, solubilities, melting point determinations, elementary analyses, and analyses for glycerol, sugars, fatty acids, and inositol have been obtained. The inositol phosphatide fraction was subjected to various acid and alkaline hydrolyses. The water-soluble hydrolysis products have been chromatographed and have been found to consist of inositol, inositol phosphate, glycerol, glycerophosphate, sugars, amino acids, and unidentified compounds. Gas chromatography has been used to identify and quantitate the fatty acids of the inositol phosphatide fraction, which have been found to consist of palmitic, stearic, and oleic acids to the extent of 58, 11, and 31 mol percent, respectively.

On the basis of the analytical data some discussion of the purity and composition of the inositol phosphatide fraction, and of the possible structure of the inositol phosphatide component has been presented.

Microfilm $2.00; Xerox $5.80. 117 pages.

A STUDY OF PROGESTERONE METABOLISM.

(L. C. Card No. Mic 59-4396)

Solomon Notrica, Ph.D.
University of Southern California, 1959

Chairman: Professor Ware

One of the primary functions of the hormone progesterone is to maintain normal pregnancy. In the habitual aborter, there may be insufficient production or abnormal metabolism of progesterone as determined by a study of its major urinary metabolite, pregnane-3α-20α-diol. The primary objective of this study was to investigate possible abnormalities in progesterone metabolism in the habitual aborter. A secondary objective was to evaluate the Klopper procedure for the determination of urinary pregnanediol.

Possible derangements in progesterone metabolism were investigated by studying urinary metabolites following administration of progesterone-4-C^{14} to normal women and to habitual aborters. The radioprogesterone was given on two occasions with and without a large amount of carrier progesterone. Under conditions of load an attempt was made to induce a physiological state simulating that in pregnancy.

The reliability of the Klopper procedure was evaluated by studying the recovery of pregnanediol at various steps. Recoveries ranged from 90 to 100 per cent. Incubation of urine with enzyme (β-glucuronidase) did not significantly alter the results obtained with hot acid hydrolysis.

Urinary excretion of 17-ketosteroids and 17-ketogenic steroids was also determined in each group of women. In the normal women the levels of these steroids were decreased following administration of progesterone load. In the aborter group the basal levels of 17-ketosteroids and 17-ketogenic steroids were lower than those in the normal. Under progesterone load these steroids decreased in the normals but were increased in the aborters.

The endogenous production of progesterone was determined by using the principle of isotope dilution. Endogenous production in three out of four of the aborters was found to be approximately twice that in the normals. The value for the fourth aborter did not differ from the normal.

There was considerable variation in the total excretion of radioactivity in both groups after tracer doses. However, following progesterone load, the excretion of radioactivity was decreased only in the aborter group.

In each group of women, metabolites in the urine were investigated following the administration of radioprogesterone. Urinary extracts were separated by paper chromatography into three fractions. Each fraction was further separated by paper chromatography with other solvent systems. Fraction I contained radioactive compounds more polar than pregnanediol. Fraction II contained pregnanediol and compounds with polarities similar to that of pregnanediol. Fraction III contained one radioactive compound, pregnan-3α-ol-20-one, which was less polar than pregnanediol.

The amount of the administered radioprogesterone converted to pregnanediol varied from 11 to 31 per cent in the normal group. In the aborter group the conversion ranged from 8 to 14 per cent. Under conditions of load, progesterone conversion to pregnanediol was decreased in both groups except in one patient of the aborter group. Variable conversions to pregnanolone were observed in both groups.

From these data it was concluded that the Klopper procedure is a satisfactory measure of urinary pregnanediol. Enzymatic hydrolysis offers no particular advantage over acid hydrolysis if the study is concerned only with the quantity of pregnanediol excreted.

Excretion of 17-ketosteroids and 17-ketogenic steroids as well as endogenous production of progesterone was sufficiently different in both groups to warrant a more detailed investigation of the differences within these parameters.

Although there were no qualitative differences in the excretion pattern of progesterone metabolites between these two groups of women, quantitative differences may become more apparent with a larger group whose clinical status is more rigidly defined.

Microfilm $2.00; Xerox $5.80. 120 pages.

PARATHYROID HORMONE AND PARTURIENT PARESIS IN DAIRY CATTLE.

(L. C. Card No. Mic 59-4172)

Albert R. Pappenhagen, Ph.D.
Purdue University, 1959

Major Professor: H. D. Jackson

Parturient Paresis or milk fever as it is frequently called has been a problem to the dairy farmer for only about 200 years. The incidence of milk fever has increased over the years as the dairy farmer has controlled his breeding practices to increase milk production. Today effective means of treating milk fever are available to the veterinarian and the mortality rate has been reduced from 60 to 70% to less than 1%.

Cows with milk fever have a low level of blood calcium and it appears that such animals are unable to mobilize calcium at a rate sufficient to meet the demands of beginning lactation. In preliminary experiments, EDTA, a calcium chelating agent, was used to evaluate the calcium mobilizing ability of rats. In these experiments it was found that intact rats could resist alterations in the level of plasma calcium while thyroparathyroidectomized rats could not. In these experiments, EDTA was administered subcutaneously and had little or no effect on the level of plasma magnesium or phosphorus.

EDTA has also been used to evaluate the calcium mobilizing ability of dairy cows. When EDTA was injected subcutaneously a slight depression in the plasma calcium was observed. However, this method was not practical with cattle since large volumes of EDTA solution were required. Although slight difference in breeds were observed when EDTA was rapidly injected intravenously in dairy cows, this technique was of little value in differentiating between the calcium mobilizing ability of different animals.

If EDTA was slowly infused via a jugular catheter the level of plasma calcium could be depressed slowly to fairly low levels. By observing the amount of this depression, the rate at which the level of calcium returns to normal, and by knowing the amount of EDTA infused, it was possible to estimate the calcium mobilizing ability of an animal. The calcium mobilizing ability of dairy animals tested in this manner indicated that young animals could mobilize calcium from body stores more rapidly than could the older animals. Parathyroid hormone did not appear to alter the rate of calcium mobilization appreciably. It has also been shown that the milking animal could mobilize calcium at a faster rate than could the animal that was not secreting milk.

Parathyroid hormone administered within two hours postpartum did not alter the blood patterns of calcium, magnesium, alkaline phosphatase or inorganic phosphorus in first calf heifers and mature animals which had never had milk fever. Animals with past milk fever histories which received parathyroid hormone within two hours postpartum and did not have milk fever at this calving had blood patterns similar to the mature animals. Although the basic physiological cause of milk fever remains unelucidated the data presented here suggest that two types of milk fever can be recognized. Mild cases of milk fever result primarily from a low level of plasma calcium while severe cases of milk fever, those requiring more than one treatment, appear to result from low levels of both calcium and inorganic phosphorus.

Microfilm $2.00; Xerox $5.80. 118 pages.

STUDIES ON DEOXYRIBONUCLEIC ACID IN TERMS OF ITS HETEROGENEITY.

(L. C. Card No. Mic 59-3902)

Herbert Rosenkranz, Ph.D.
Cornell University Medical College, 1959

Deoxyribonucleic Acid (DNA) can be adsorbed to and eluted from the substituted cellulose anion-exchanger ECTEOIA to yield reproducible fractions. When this procedure was applied to DNA preparations from various sources, chromatographic profiles were obtained. The fractions obtained by this chromatographic method have been found to differ in base composition and sedimentation coefficients. This therefore indicates that this chromatographic separation of DNA is based in part on differences of base composition and size and shape. Such fractions also vary in their ability to serve as primers in the enzymatic synthesis of DNA and vary in their transforming activity when obtained by fractionation of biologically active pneumococcal DNA. DNA fractions from calf thymus vary in their ability to inhibit the transforming activity of pneumococcal DNA. This would indicate that the different biological properties are associated with DNA molecules of different physical and chemical properties. The chromatographic method proved to be a valuable tool in the study of the effects on DNA of a number of physical and chemical agents such as the effect of heating in the presence and absence of salt, exposure to sonic vibrations, and treatment with nitrous acid.

Microfilm $2.65; Xerox $9.20. 203 pages.

THE PROPERTIES OF ASPARTASE.

(L. C. Card No. Mic 59-4566)

Ronald McLean Scott, Ph.D.
University of Illinois, 1959

A study of the properties of the enzyme aspartase was undertaken. The reaction catalysed is the reversible cleavage of aspartate to fumarate and ammonia. A comparison of four bacterial strains led to the selection of Bacterium cadaveris, strain Gale, as a source of aspartase. The products and reversibility cf aspartate cleavage as catalysed by whole cells were observed.

Cell free extracts from Bacterium cadaveris were prepared, and methods of purifying aspartase activity from these extracts were developed. Aspartase preparations free of enzymes catalysing side reactions were obtained, and these were more highly purified than any previously reported.

With these extracts enzyme properties were studied. Optimum aspartate cleavage by aspartase occurred at pH 7.8. The reaction was found to have the expected

stoichiometry (one mole of aspartate cleaved to form one mole each of fumarate and ammonia). No cofactors were required for aspartate cleavage with purified preparations. D aspartate was untouched by the enzyme. The Michaelis Constant was 1.29×10^{-2}M for the cleavage of aspartate.

Recently two systems involving aspartate and fumarate have been studied. One involves the conversion of inosine-5'-phosphate and aspartate through adenylosuccinate to adenosine-5'-phosphate and fumarate, and the other concerns the conversion of citrulline and aspartate through arginosuccinate to arginine and fumarate. Evidence was obtained that the aspartase of B. cadaveris does not operate by either of these pathways.

The effect of chelating agents on the reaction was studied, and versene dialysis was found to inactivate about 90% of the ability of aspartase to cleave aspartate. This activity was completely restored by incubation for one hour with magnesium ion and inosine-5'-phosphate, but only partially restored by one of the additions alone. Various nucleosides and nucleotides were assayed for their ability to restore activity to versene dialysed preparations. Adenosine-5'-phosphate, guanosine-5'-diphosphate, and adenosine were stimulatory, but less so than inosine-5'-phosphate. Guanosine-5'-triphosphate was inhibitory. The amount of inosine-5'-phosphate required to saturate the enzyme was measured. Divalent metal ions were surveyed for ability to restore activity to versene dialysed preparations. Mn^{++}, and Co^{++} were equally as good as Mg^{++}, but Fe^{++} was ineffective.

The removal of cofactor from aspartase by ion exchange resins was studied, and conditions were found under which Dowex-1-Cl was effective. Restoration of activity to the preparation was accomplished with inosine-5'-phosphate. Microfilm $2.00; Xerox $4.20. 77 pages.

SOME BIOPHYSICAL PROPERTIES OF THE T_3 BACTERIOPHAGE OF ESCHERICHIA COLI.

(L. C. Card No. Mic 59-4472)

Louis George Swaby, Ph.D.
University of Pittsburgh, 1959

The T_3 bacteriophage is one of the seven bacteriophages designated as T phages and active on strain B of the bacterium Escherichia coli. Most of these have been studied with regard to their chemical and biological properties and all have been examined with the electron microscope. Only the T_2 and T_6 phages, however, have been completely characterized in terms of their biophysical properties. This work was therefore performed to provide the biophysical characterization of the T_3 phage.

E. coli B was grown to counts of 10^9 per ml, in three liter batches of a glycerol-casamino acid medium. At this bacterial concentration enough T_3 bacteriophage was added to give a multiplicity of approximately two phage particles per bacterium. Incubation and aeration continued until lysis occurred as indicated by the clearing of the medium. The resulting bacteriophage solutions were purified and concentrated by filtration and differential centrifugation. All solutions were made with 0.1 ionic strength phosphate buffer at pH 7 containing 0.005M magnesium sulfate. The final solutions titered around 10^{13} infective units per ml, and represented about 30 per cent recovery.

Electron microscopy was performed with solutions dialyzed against distilled water. The solutions were sprayed onto collodion films and shadowed with uranium. The diameter observed for shadowed particles was 73 m μ and for unshadowed particles it was 59 m μ. The height as calculated from the shadow lengths was 37 m μ and was attributed to flattening due to surface tension. Combination of this figure and 73 m μ for the diameter yielded a value of 58 m μ for the equivalent sphere. Small tails were seen on most of the particles.

Solutions used in electron microscopy were also used for the determination of the apparent partial specific volume and specific refractive increment. Densities were determined with density gradient columns, refractive index differences with a differential refractometer and concentrations by vacuum drying of known volumes of solution. The mean values were 0.65 ml/gm. and 1.80×10^{-3} 100 ml/gm. for the specific volume and refractive increment, respectively.

Sedimentation of the bacteriophage was studied in solutions of varying concentration, density, and pH. In the experiments at different concentrations the sedimentation rates were corrected to standard conditions by employing both solution density and viscosity and solvent density and viscosity. Both sets of data gave a value of 476 svedbergs for the sedimentation constant, S^{w}_{20}. Experiments at different densities indicated an effective partial specific volume of 0.79 ml/gm. for the bacteriophage in sucrose solutions of densities around 1 gm./ml. No dependence of sedimentation rate or virus activity on pH was found between pH 5.5 and pH 8.9.

A Spinco model H apparatus was used for the determination of diffusion coefficients. Both schlieren and interference optics were used with the interference optics giving more precise results. The measurements were made at 1.8°C. and corrected to standard conditions. The measurements indicated no concentration dependence and a mean value of 0.673×10^{-7} cm.^{2}/sec.

With the above experimental values and use of the Svedberg equation a value of 49×10^6 was obtained for the molecular weight of the T_3 bacteriophage. This figure corresponds to an anhydrous sphere with a 23.3 m μ radius.

The experimental friction ratio was calculated to be 1.37. On the basis of the electron microscope results this value can be interpreted as being due to a hydration of 1.02 ml of water per gram of bacteriophage. The sedimenting unit, therefore, had a radius of 32 m μ.

Microfilm $2.00; Xerox $5.20. 104 pages.

STUDIES ON THE FUNCTION OF VITAMIN B_{12}.

(L. C. Card No. Mic 59-4582)

Shreepad Ramchandra Wagle, Ph.D.
University of Illinois, 1959

The role of vitamin B_{12} in nucleic acid and protein biosynthesis has been studied by the use of various labeled precursors. The results obtained show that vitamin B_{12} is not directly involved in the synthesis of purines and pyrimidines from 1-carbon precursors such as formaldehyde, formate, glycine, serine and methionine. Studies with C^{14} glucose also indicate that it is involved neither in the

conversion of glucose to ribose or deoxyribose nor in the incorporation of these pentoses into nucleic acids.

Vitamin B_{12} deficient pigs and rats were found to incorporate less activity from injected uniformly labeled C^{14} glucose and C^{14} serine into liver protein. The incorporation of amino acids into protein in vitro was studied within the system prepared from microsomes and the pH 5 enzymes fraction of rat liver. A reduced incorporation of amino acids into protein was observed in pH 5 enzymes microsomal preparation obtained from vitamin B_{12} deficient animals. This reduction could be partially overcome by the addition of crystalline vitamin B_{12} and completely by the addition of pH 5 enzymes preparation from vitamin B_{12} normal animals. The incorporation of radiophenylalanine in the presence of 19 other amino acids was much greater than that of a single amino acid indicating a requirement for a pool of amino acids and strongly suggesting net synthesis of protein. Here again the marked effect of vitamin B_{12} was observed.

Ammonium sulfate fractionation of the pH 5 enzymes preparation led to a 2-fold increase of amino acid incorporation into protein. Addition of a vitamin B_{12} antagonist to the pH 5 enzymes microsome system inhibited the incorporation of amino acid by 40 per cent. This inhibition could be partially overcome by the addition of excess pH 5 enzymes and almost completely by the addition of 20-60 per cent ammonium sulfate fraction. The 40-60 per cent ammonium sulfate fraction enzyme incorporated pyrophosphate activity (PP^{32}) into adenosine triphosphate when incubated with adenosine triphosphate, amino acid, enzyme and P^{32} labeled pyrophosphate. This exchange could be inhibited by the addition of B_{12} antagonist.

A distribution study of Co^{60} labeled vitamin B_{12} administered to a rat showed it to occur principally in the microsome pH 5 enzymes fraction. The data presented indicates a role of vitamin B_{12} in protein synthesis.

Microfilm $2.00; Xerox $3.60. 63 pages.

FACTORS AFFECTING CHOLESTEROL ABSORPTION AND METABOLISM.

(L. C. Card No. Mic 59-4406)

Arthur F. Wells, Ph.D.
University of Southern California, 1959

Chairman: Professor Alfin-Slater

The use of unsaturated vegetable oils in place of animal fats has been widely advocated for the prevention and control of hypercholesterolemia and atherosclerosis. The effects of these oils on hypercholesterolemia have been variously ascribed to their content of essential fatty acids, to their content of plant sterols, or to a combination of both these factors. Studies were undertaken to determine the effects of plant sterols and of essential fatty acid deficiency on the absorption and metabolism of cholesterol in the rat. During the course of these studies, additional information has been obtained concerning the absorption and metabolism of cholesterol in the normal, unsupplemented animal.

It has been found that, in the normal rat, an excess of cholesterol in the liver rapidly disappears when cholesterol feeding is discontinued. The disappearance of excess cholesterol conforms to apparent first order reaction kinetics with a half-life of four to six days. Plant sterols have no effect on the rate of this reaction.

Plant sterols completely inhibit the absorption of dietary free cholesterol when the ratio of plant sterol to cholesterol is 3:1. The absorption of cholesterol esters is also effectively, and almost completely prevented. In addition, esterified plant sterols inhibit the absorption of both free and esterified cholesterol.

In an attempt to resolve the question of whether or not plant sterols exert their effect on cholesterol absorption by combining with cholesterol in the intestinal lumen to form an unabsorable complex, cholesterol and plant sterols were fed on alternate days. Under these conditions, cholesterol absorption was also prevented.

The absorption of cholesterol in the essential fatty acid deficient rat has also been studied. It has been found that these animals are unable to absorb free cholesterol. The addition of bile salts to the diet of these animals, however, restores cholesterol absorption. Supplementation with dietary bile salts is not required for absorption of cholesteryl linoleate.

The addition of bile salts to the diet of male rats deficient in essential fatty acids results in a further increase in the elevated liver cholesterol level of such animals. Supplementation with β-sitosterol results in a decrease in liver cholesterol levels. Similar additions to the diets of normal rats result in only minimal changes in liver cholesterol levels. Microfilm $2.00; Xerox $4.40. 81 pages.

CHEMISTRY, INORGANIC

REACTIONS OF MOLYBDENUM (III) CHLORIDES IN NON-AQUEOUS SULFURIC ACIDS AND RELATED SOLVENTS.

(L. C. Card No. Mic 59-611)

Lionel J. Bailin, Ph.D.
Tulane University, 1958

Supervisor: Hans B. Jonassen

Lyons' theory* which states that electroreduction of metals from ions occurs in aqueous solution only when the coordinate linkages involve "outer orbitals" has been tested for non-aqueous systems. Molybdenum salts of lower valence, potassium hexachloromolybdate (III) and molybdenum (III) chloride, were dissolved in various non-aqueous sulfuric acids and certain organic solvents to form complex ions. These ions were studied on the basis of oxidation state lability with respect to substitution, spectra, and electrolytic reactions.

From visible and ultra-violet spectral data, it was shown that certain peaks in the $MoCl_3$ - concentrated H_2SO_4 solution absorption range were similar to those present in the K_3MoCl_6 - concentrated H_2SO_4 solution which had been heated. This explains the deposition of coatings from hot K_3MoCl_6 - H_2SO_4 solutions. Cold K_3MoCl_6 - concentrated H_2SO_4 gave no deposits as long as the "inner orbital" configurations were retained.

Molybdenum (III) chloride was found to be inert in contact with gaseous sulfur trioxide, while potassium hexachloromolybdate (III) formed addition products readily. Consideration of the K_3MoCl_6 solid - SO_3 gaseous reaction indicated reversibility within fixed temperature limits. The sulfur trioxide reacting with the potassium hexachloromolybdate (III) yielded adducts containing 4 to 14 "SO_3" molecules. Oxidation states for molybdenum were 3.00 at low temperature, 90°; and 4.00 for high temperature, 180°. To test Lyons' theory, these data were correlated with "inner orbital" complexes that form when potassium hexachloromolybdate (III) dissolves in fuming sulfuric acid.

Electrolysis of the lower valence molybdenum (III) chloride-organic solvent complexes indicated that electrodeposits were not obtained when inner orbital complexes were involved.

Electrolytic studies were carried out on the $MoCl_3$ and K_3MoCl_6 - sulfuric acid solutions. Black deposits of molybdenum sulfides of lower valence were produced from all $MoCl_3$ - sulfuric acid solutions. Electrolysis of potassium hexachloromolybdate (III) yielded little or no deposits from fuming sulfuric and chlorosulfonic acid solvents. K_3MoCl_6 - concentrated H_2SO_4 gave non-uniform poorly reproducible deposits.

The mechanism for the electroreduction is postulated to involve reaction at the cathode of reduced, active sulfur derived from the sulfuric acid with molybdenum ions of lower oxidation state. On the basis of Lyons' theory, potassium hexachloromolybdate (III) as an inner orbital complex would not be expected to yield a deposit or an ionic species which would allow complete reduction to the metallic state.

The oxidation states of the molybdenum ions in the non-aqueous sulfuric acid solutions were determined by a new method. Excess standard potassium dichromate-concentrated sulfuric acid solution was used to oxidize the molybdenum to its VI valence state. The remaining dichromate was determined by titration with aqueous ferrous sulfate. Both molybdenum (III) chloride and potassium hexachloromolybdate (III) in cold concentrated sulfuric acid solutions gave values of 3.00 for the oxidation state of the molybdenum. Heating the solutions caused oxidation to occur.

Complexes were formed when molybdenum (III) chloride and potassium hexachloromolybdate (III) dissolved in concentrated and fuming sulfuric acids; the rate of formation increased with increasing SO_3 content.

Intensities of X-ray diffraction patterns obtained from the black deposits were very weak. Sufficiently long exposures, however, allowed recording of a series of lines not listed in the ASTM card index. Theoretical molybdenum percentages for molybdenum polysulfide and dimolybdenum trisulfide agreed within the experimental error with results obtained by gravimetric analysis of the deposits.

As a result of complex formation in pyridine, a new method for the preparation of $MoCl_3 \cdot (pyridine)_3$ was developed. The procedure entails relatively rapid reaction of K_3MoCl_6 and pyridine at the reflux temperature at normal pressure. Microfilm $2.00; Xerox $6.40. 133 pages.

*Ernest H. Lyons, Jr., Electronic Configuration in Electrodeposition from Aqueous Solution: Part I, The Effect of Ionic Structure, Journal of the Electrochemical Society, 101, 363-75 (1954).

THE STRUCTURE AND STABILITY OF SOME METAL COMPLEXES OF BIOCHEMICAL INTEREST.

(L. C. Card No. Mic 59-4436)

Graeme Everett Cheney, Ph.D.
University of Pittsburgh, 1959

The purpose of this work has been to obtain information on the manner in which sulfur, in the mercaptide ion, complexes with metal ions, in order that a further understanding of the role played by this functionality in inorganic analysis and trace metal metabolism may be reached.

The acid dissociation constants of purine and some of its 6-substituted derivatives have been determined potentiometrically. A correlation of the relative basicity of these compounds revealed that only 6-aminopurine (adenine) was appreciably basic; hence, it was concluded that the presence of the amino group in the six position of purine confers the basicity on the system. The acidity of the imino group was related to possible electronic effects of the substituents in the six position.

A comparison of complex formation constants with certain divalent metal ions revealed that 6-mercaptopurine formed more stable complexes with these metal ions than the oxygen analogue, 6-hydroxypurine. This greater complex stability was attributed to the participation of the sulfur atom in the metal-ligand bond. Preliminary evidence was obtained that 6-mercaptopurine reduced copper (II) to copper (I).

The acid dissociation constants of mercaptosuccinic acid were determined potentiometrically, and chelate formation constants with nickel (II), zinc (II) and cobalt (II) evaluated by the Calvin-Bjerrum technique. Evidence was obtained that mercaptosuccinic acid behaves as a tridentate reagent in a one to one chelate, and bidentate in a two to one chelate.

The reduction of copper (II) to copper (I) by mercaptosuccinic acid was investigated and shown to bear resemblance to the similar reduction of copper (II) with cysteine as the mercaptan.

8-Mercaptoquinoline was synthesized from quinoline-8-sulfonic acid and its infrared and ultraviolet spectra determined, and compared with similar data available on 8-quinolinol. Microfilm $2.00; Xerox $5.60. 113 pages.

COMPOUNDS OF PLATINUM IN THE ZERO OXIDATION STATE.

(L. C. Card No. Mic 59-4764)

James Wilkinson Dawes, Ph.D.
The University of Texas, 1958

Supervisor: George W. Watt

The reactions of $[Pt(en)_2]I_2$ with one, two, and three molar equivalents of potassium amide in liquid ammonia at -33.5° are shown to yield $[Pt(en\text{-}H)(en)]I$, $[Pt(en\text{-}H)_2]^0$, and $K[Pt(en\text{-}2H)(en\text{-}H)]$, respectively. Certain reactions of these species in both liquid ammonia and water are described.

The reduction of $[Pt(en)_2]I_2$ with one equivalent of

potassium in ammonia is shown to lead to an unstable $[Pt(en)_2]I$ which decomposes at -33.5° to form [Pt(en-H)(en)]I and hydrogen, and disproportionates at higher temperatures to $[Pt(en)_2]I_2$ and $[Pt(en)_2]^0$. The latter decomposes to form $[Pt(en\text{-}H)_2]^0$, hydrogen, platinum, and ethylenediamine. The reduction of $[Pt(en)_2]I_2$ with two equivalents of potassium provides $[Pt(en)_2]^0$ which decomposes in the manner indicated above, passing through the intermediate step $[Pt(en\text{-}H)(en)]^0$.

Microfilm $2.00; Xerox $3.00. 54 pages.

REACTIONS OF DISILOXANE AND SILYL CYANIDES WITH SIMPLE COMPOUNDS OF ALUMINUM AND BORON.

(L. C. Card No. Mic 59-4641)

William Arthur Kriner, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Alan G. MacDiarmid

The present investigation was carried out in order to extend the knowledge of the chemistry of silyl compounds, the analog of methyl compounds by studying the reactions involving disilyl ether with aluminum halides, and the reactions of silyl cyanides with simple boron compounds.

$(CH_3)_4Al_2Br_2$ and $(SiH_3)_2O$ were found to react at -50° to give a solid adduct which decomposed below 0°. The overall reaction may be represented by the equation

$$(CH_3)_4Al_2Br_2 + 2(SiH_3)_2O \longrightarrow (CH_3)_4Al_2(OSiH_3)_2 + SiH_3Br \quad (1)$$

Vapor density measurements on the new siloxyaluminum compound showed it to be the dimer $[(CH_3)_2AlOSiH_3]_2$. The compound was completely characterized.

At -78° the compound was completely stable, but decomposed slowly at room temperature and rapidly at 80-90° to give SiH_4 and approximately equal quantities of a volatile liquid and a non-volatile viscous product. The volatile liquid was partly characterized and is thought to be a condensation product, $[(CH_3)_2AlO]_2SiH_2$, formed according to the equation

$$(CH_3)_4Al_2(OSiH_3)_2 \longrightarrow [(CH_3)_2AlO]_2SiH_2 + SiH_4 \quad (2)$$

The non-volatile product is probably a more highly condensed product.

Aluminum (III) halides, Al_2I_6, Al_2Br_6, and Al_2Cl_6, were found to cleave the Si-O linkage in $(SiH_3)_2O$ at low temperatures. Reaction commenced at -78° and was complete after slowly warming to room temperature over a period of one to two hours. The reaction may be represented by the general equation

$$2n(SiH_3)_2O + Al_2X_6 \longrightarrow (SiH_3O)_{2n}Al_2X_{6-2n} + 2nSiH_3X \quad (3)$$

(where n = 1, 2 or 3)

The siloxyaluminum compounds formed in this reaction were non-volatile presumably polymeric solids. The siloxyaluminum halides formed when n was < 2 in equation (3) were found to catalyze the disproportionation of SiH_3X according to the reaction

$$2SiH_3X \xrightarrow{(SiH_3O)_{2n}Al_2X_{6-2n}} SiH_2X_2 + SiH_4 \quad (4)$$

The siloxyaluminum compounds decomposed on heating to form SiH_4, a non-volatile solid and in most cases SiH_3X and/or SiH_2X_2.

Silyl cyanide was found to form an adduct with diborane according to the reaction

$$2H_3SiCN + B_2H_4 \longrightarrow 2H_3SiCN \cdot BH_3 \quad (5)$$

The adduct decomposed slowly and irreversibly at room temperature and more rapidly at 80° according to the equation

$$H_3SiCN \cdot BH_3 \longrightarrow SiH_4 + BH_2CN \quad (6)$$

BH_2CN was found to be a rubbery, polymeric, glassy solid which was stable at room temperature and was insoluble in common organic solvents. Its infrared spectrum showed partial reduction of the C≡N bond. The compound decomposed slowly on heating to give H_2.

A similar reaction between silyl cyanide and boron halides gave an adduct according to the equation

$$H_3SiCN + BX_3 \longrightarrow H_3SiCN \cdot BX_3 \quad (7)$$

(where X = F or Cl)

The adduct decomposed rapidly on raising the temperature to room temperature according to the equation

$$H_3SiCN \cdot BX_3 \longrightarrow SiH_3X + BX_2CN \quad (8)$$

The residue BF_2CN and BCl_2CN were non-volatile presumably polymeric solids which decomposed on heating to give BX_3 and a black solid.

Trimethylsilyl cyanide gave similar reactions with BCl_3.

Trimethylsilyl cyanide was found to react rapidly and quantitatively with di-n-butylboron chloride as shown in the equation

$$(n\text{-}C_4H_9)_2BCl + (CH_3)_3SiCN \rightarrow (n\text{-}C_4H_9)_2BCN + (CH_3)_3SiCl \quad (9)$$

The compound $(n\text{-}C_4H_9)_2BCN$ is a viscous polymeric liquid which decomposed at 300° to give butane and a resinous solid. It reacted with ammonia to form the adduct $(n\text{-}C_4H_9)_2BCN \cdot NH_3$. When a solution of $(n\text{-}C_4H_9)_2BCN$ in liquid NH_3 was treated with Na, $(n\text{-}C_4H_9)_2BNH_2$ was liberated according to the reaction

$$2(n\text{-}C_4H_9)_2BCN \cdot NH_3 + Na \longrightarrow 2(n\text{-}C_4H_9)_2BNH_2 + 2NaCN + H_2 \quad (10)$$

The $(n\text{-}C_4H_9)_2BNH_2$ was isolated as a monomer but slowly condensed to the dimer on standing.

Preliminary experiments demonstrated that $(CH_3)_3SiCN$ and $(CH_3)_3B$ interacted readily at room temperature to form a white solid, which was presumably an adduct. When they were heated together at 100°, regardless of whether excess $(CH_3)_3SiCN$ or $(CH_3)_3B$ were used, the following rearrangement occurred:

$$(CH_3)_3SiCN + (CH_3)_3B \longrightarrow \text{adduct} \longrightarrow (CH_3)_3SiC(CH_3)=NB(CH_3)_2 \quad (11)$$

Interpretation of the reaction was complicated by the fact that the compound formed initially appeared to condense spontaneously and to simultaneously rearrange and polymerize.

All the above experimental results are entirely consistent with the known chemistry of both simple and substituted silyl compounds. Microfilm $2.00; Xerox $4.00. 73 pages.

LOWER OXIDATION STATES OF THORIUM.

(L. C. Card No. Mic 59-4768)

Satish Chandra Malhotra, Ph.D.
The University of Texas, 1958

Supervisor: George W. Watt

Thorium and iodine in various proportions were heated under reduced pressure for 3 days at 550° and the resulting mixtures consisted of lower iodides of thorium along with unreacted thorium and traces of thorium(IV) iodide. The latter was removed from the mixtures by sublimation and the unreacted thorium in the non-volatile products was separated by treating the mixtures with perchloric acid solution at pH = 1 and room temperature, whereupon the iodides of thorium dissolved; I/Th ratios were established for the resulting acid-soluble fractions.

Upon treatment with liquid ammonia at -33.5°, the thorium(III) iodide present in the non-volatile product reacted according to,

$$ThI_3 + 5NH_3 \rightarrow Th(NH_2)I_3 \cdot 4NH_3 + 1/2\ H_2$$

The ammonia-soluble products consisted of a mixture of ammonium iodide and one or more ammonobasic iodides of thorium. The ammonium iodide was separated from the latter by virtue of its solubility in absolute alcohol and acetone.

The ammonia-insoluble fractions consisted of thorium and iodides of thorium(II) and (I). After separation of the thorium from the mixtures by the perchloric acid treatment, I/Th ratios were established for the acid-soluble fractions. That these lower iodides were not formed by disproportionation of thorium(III) iodide is indicated by the fact that, with decrease in the I/Th ratio in the original reaction mixture, the lower iodide content of the product increased. This is also supported by the demonstrated stability of thorium(III) iodide at 550°. Assuming that thorium(II) iodide is diamagnetic, magnetic susceptibility data support the conclusion that iodides of thorium(<III) are formed in these reactions.

Thorium(II) iodide was separated from the ammonia-insoluble fractions by virtue of its solubility in N,N-dimethylformamide, and the thorium was separated from the resulting dimethylformamide-insoluble fractions by the perchloric acid treatment.

Conditions were determined for complete halogen exchange in the system ThI_4-CCl_4. Under the most favorable conditions, the resulting carbon tetrachloride-insoluble products gave Cl/Th ratios varying from 3.85 to 3.96 and included very small quantities of covalently bonded chlorine, iodine, and carbon. The X-ray diffraction patterns for these products did not correspond to any known compound. However, on heating under reduced pressure in a Vycor tube, ca. 90% of the insoluble product appeared as a white sublimate of thorium(IV) chloride. The non-volatile residue consisted of a mixture of elemental carbon and thorium(IV) oxide.

Appearance of free iodine during sublimation and the presence of covalent halogen and carbon (over and above that found as elemental carbon) in the insoluble residue can be attributed to adsorption of substituted methane(s) on the elemental carbon and/or thorium(IV) chloride.

Although there is ample precedent for free radical mechanisms, the products actually identified can be accounted for by the simple equations,

$$ThI_4 + CCl_4 \rightarrow ThCl_4 + CI_4$$

$$CI_4 \rightarrow C + 2I_2$$

$$ThI_4 + 4CCl_4 \rightarrow ThCl_4 + 4CCl_3I$$

Free iodine and trichloroiodomethane in the carbon tetrachloride solution were detected spectrophotometrically. Free iodine can be accounted for as arising from two sources, i.e., thermal decomposition of the carbon tetraiodide and photochemical decomposition of the thorium(IV) iodide. Microfilm $2.00; Xerox $5.00. 100 pages.

INORGANIC COMPLEX COMPOUNDS CONTAINING POLYDENTATE GROUPS: STUDIES OF TETRAMINE AND PENTAMINE COMPLEXES OF COBALT(II), NICKEL(II), MANGANESE(II) AND IRON(II) IONS.

(L. C. Card No. Mic 59-4202)

Vendatapuram Vuruppattur Ramanujam, Ph.D.
Tulane University, 1958

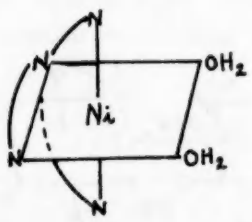
Chairman: Hans B. Jonassen

Investigation of the nature of the complex ions formed between cobalt(II) ions and triethylenetetramine (abbreviated trien) and tris-(2-aminoethyl)amine (abbreviated ten) in basic solution revealed the existence of the ions $[Cotrien(OH)_2]$ and $[Co_2tren_2(OH)_3]^+$ in addition to $[Cotrien]^{2+}$ and $[Cotren]^{2+}$. Of these, while the trien complex was oxidized by H_2O_2 the binuclear tren complex decomposed H_2O_2 catalytically (1). This process is similar to that found by Wang (2) in the case of $[Fetrien(OH)_2]^+$.

It was postulated that the cobalt-trien complex was oxidized by H_2O_2 because of the hydroxyls in the trans positions. Attempts to substantiate this by magnetic susceptibility measurements proved unsuccessful because both the trien and tren complexes showed a moment corresponding to one unpaired electron.

These studies were extended to complexes possible between nickel(II) ions and the two isomeric tetraamines.

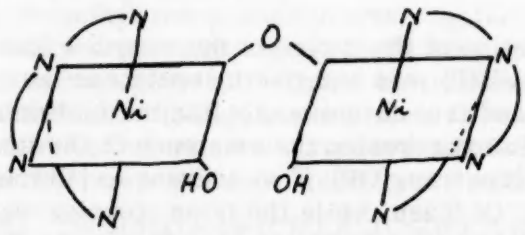
Mixtures of nickel(II) perchlorate and the amine hydrochloride in equimolar ratios were titrated against NaOH by conductometric, potentiometric and spectrophotometric methods. The two species $[Nitrien]^{2+}$ and $[Nitrien(OH)_2]$ were found to be formed between nickel(II) ions and trien, while the two species $[Nitren]^{2+}$ and $[Ni_2tren_2(OH)_3]^+$ were found in the nickel(II)-tren system. The complex $[Nitren]^{2+}$ was postulated to be an octahedral complex with H_2O in the cis positions.



The variation in magnetic susceptibility during the titration with NaOH showed that in the Ni-trien system, the susceptibility decreases until all the HCl of the hydrochloride is neutralized and the complex ion $[Nitrien]^{2+}$ was

diamagnetic. Further addition of OH^- made the complex paramagnetic and when two more equivalents of OH^- had been added the moment corresponded to two unpaired electrons. These observations suggest that the ion $[Nitrien]^{2+}$ is planar, probably with two water molecules in trans positions at distances larger than the planar metal-ligand distances. The amine nitrogens of the trien occupy the four planar positions with the d_{z^2} orbital filled with a pair of electrons. The water molecules could then bond weakly using 4p4d outer orbital hybrid bonds. Further addition OH^- ions results in a d_γ, d_ε split in the levels and the susceptibility of the trans bis-hydroxo complex increases, reaching that expected for two unpaired electrons occupying the d_{z^2} and $d_{x^2-y^2}$ levels typical of octahedral complexes of metal ions with a d^8 configuration.

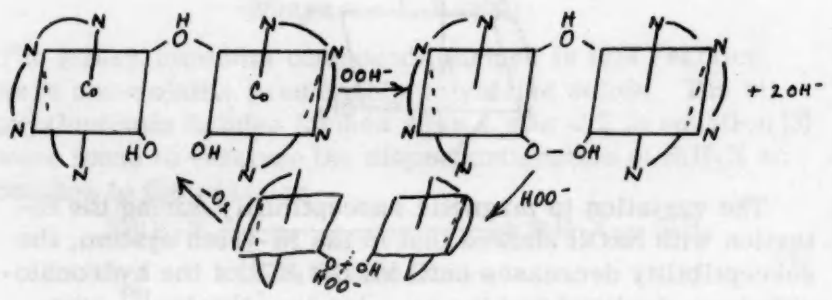
The tren complex is paramagnetic and the metal ion has two unpaired electrons, suggesting an sp^3 type bonding to the nitrogen atoms of the amine with water molecules in cis octahedral positions bonded by use of outer d orbitals. Further addition of OH^- ions decreases the susceptibility and when the OH^- addition corresponded to a composition $[Nitren(OH)_{1-5}]$ or $[Ni_2tren_2(OH)_3]^+$, the complex was diamagnetic. The diamagnetism can be due to spin exchange interaction between the unpaired electrons of the nickel atoms in the bridged structure



or the formation of skewed octahedra with dsp^3d hybrid bonds, the inner d being the $d_{x^2-y^2}$ with a pair of electrons.

The decomposition of H_2O_2 when catalyzed by $[Co_2tren_2(OH)_3]^+$ (1) was investigzted with the aim of elucidating the mechanism of the reaction. It was found that as long as the amount of alkali added to the neutral solution i.e., $[Cotren]^{2+}$ did not reach a $Co(II) : OH^-$ ratio of 1:1.5, there was no catalytic activity. The reaction rate was found to be proportional to the concentration of the catalyst and of the hydrogen peroxide in the concentration range used, indicating a first order dependence on these concentrations.

That oxidation-reduction processes involving electron-transfer between metal ions could take place easily if there is an anionic bridge between the ions was suggested by Libby (4) and demonstrated by Taube and co-workers (5). A mechanism for the catalytic decomposition involving simultaneous oxidation of H_2O_2 to oxygen and reduction to OH^- has been proposed. The electron transfer, it is believed, is facilitated by the hydroxo bridge between the Cotren complex ions.



The corresponding nickel complex is also catalytically active for the decomposition of H_2O_2. However, as would be expected from the consideration that the repulsion (and the bond distance) is greater for the doubly occupied $d_{x^2-y^2}$ orbital in the Ni(II) tren complex, the effectiveness of this complex as a catalyst through the formation of a peroxidic intermediate would be less than that of the cobalt complex where only one electron occupies the $d_{x^2-y^2}$ orbital. This was found to be true, the relative first order rate constant for the decomposition being 0.17 min^{-1} for the cobalt (catalyst concentration 2.5×10^{-4} M) and 0.042 min^{-1} for the nickel complex (catalyst concentration 6.6×10^{-4} M), with Arrhenius activation energies of 8.06 and 12.52 kcal. respectively.

The manganese(II)-tetren system and the iron(II)-tetren system were investigated to find out if any binuclear complexes were present in basic solution. Conductometric, potentiometric and magnetic titrations of a mixture of the metal perchlorate and the amine hydrochloride in 1:1 ratio with sodium hydroxide were made. Evidence was found for the existence of the complex $Mn_2(tetrenH_2)_2(OH)_3^{3+}$ and in the case of iron(II) no binuclear complex was indicated, the only complex found being $[FetetrenH_2O]^{2+}$.

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Microfilm $2.00; Xerox $5.60. 111 pages.

THE REACTIONS OF DECABORANE-14 WITH ANILINE AND ITS N-METHYL HOMOLOGUES.

(L. C. Card No. Mic 59-4207)

Stephen Paul Terpko, Ph.D.
Tulane University, 1959

Chairman: Hans B. Jonassen

The reactions of the lower boranes (diborane, tetraborane and pentaborane) with ammonia and amines have been studied by many investigators in recent years.

It is well known that diborane reacts with amines as two BH_3 units. This has been termed a "symmetrical" BH_3 cleavage. With ammonia, however, an "unsymmetrical" cleavage of diborane results in the formation of BH_2^+ and BH_4^- units. The cation is stabilized by two ammonia molecules. These principles have been established by Shore, Parry and coworkers.

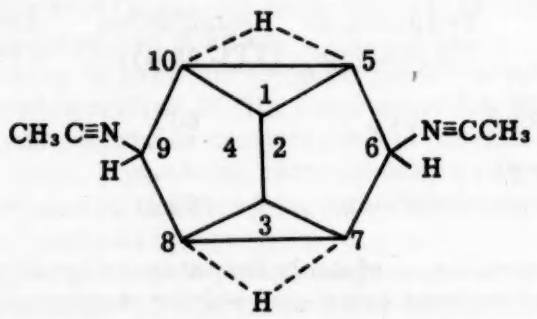
Hough et al found that tetraborane undergoes analogous BH_3 cleavage reactions with Lewis bases, in which both the BH_3 and B_3H_7 are amine stabilized. Parry et al found that tetraborane cleaved into BH_2^+ and $B_3H_8^-$ ions when reacted with ammonia, in a manner analogous to diborane.

They postulate three possible types of cleavage reactions with pentaborane: a) symmetrical BH_3 cleavage yielding BH_3 and B_4H_6 fragments; b) a double symmetrical BH_3 cleavage yielding two BH_3 and one B_3H_3 fragments; and c) an unsymmetrical (BH_2^+) cleavage yielding BH_2^+ and $B_4H_7^-$ ions. Reactions of types a and b have been supported by Burg in reactions of pentaborane with $(CH_3)_3N$.

Low temperature base addition without BHB bridge cleavage is also possible. It is generally believed that the bridging hydrogens of the boron hydrides are the reactive acidic sites for amine attack. To test this hypothesis, Field allowed pentaborane to react with substituted amines. The amine to pentaborane reaction ratios were found to be decreased as the number and size of the substituents on the amine nitrogen increased. Since the amine to pentaborane ratio never exceeded four, and in view of the apparent steric effect, he concluded that the bridging hydrogens were indeed acidic sites and that steric factors have a greater influence than the amine base strength on this ratio.

Studies of the reaction of decaborane with dimethylamine at -78° have been reported recently by Fitch and Laubengayer. It was shown that mono-, bis- and tris-dimethylamine-decaborane-14 aminates could be formed when variable ratios of decaborane-14 were reacted. These aminates were prepared without any hydrogen elimination or cleavage of the decaborane structure. The aminates were found to be stable with respect to decomposition at room temperature.

Schaefer had reported the aminate $(CH_3CN)_2B_{10}H_{12}$ to form during the reaction of decaborane with CH_3CN at its reflux temperature (81.6°). Lipscomb recently showed by single crystal X-ray studies that the nitrile was bonded to the decaborane structure at the 6 and 9 sites by BN bonds in the following manner:



Little is known about the nature of the reactions of decaborane-14 with amines at room temperature. It was the purpose of this work to investigate the reactions of decaborane-14 with aniline and its N-methyl homologues at a temperature of 35.0°.

Aniline and its N-methyl homologues react with decaborane-14 with elimination of hydrogen at 35.0°. During the reaction, a red-orange colored intermediate was observed. These reactions may be written in general form as:

$$n\ \text{amine} + B_{10}H_{14} \longrightarrow [(\text{amine})_n \cdot B_{10}H_{14}]$$
$$\longrightarrow (\text{amine})_n \cdot B_{10}H_{14-n} + \frac{n}{2} H_2$$

The following decaborane aminates were prepared: tris-aniline-decaborane-11 (41% yield); bis-N-methylaniline-decaborane-12 (95.8% yield) and bis-N,N-dimethylaniline-decaborane-12 (95.9% yield). These final products seem to indicate that steric factors control the number of ligands that may attach to a decaborane molecule. The order of decreasing inherent steric properties and the basicity determined for the amines from their ionization constants in water is:

$$C_6H_5N(CH_3)_2 > C_6H_5NHCH_3 > C_6H_5NH_2$$

The relative reaction rates were determined by observation of an increase in pressure caused by hydrogen elimination. Reaction rates were found to be in the order

$$C_6H_5NHCH_3 > C_6H_5NH_2 > C_6H_5N(CH_3)_2$$

This order of the relative reaction rates seems to indicate that either the amine steric factors or their basic strengths may predominate for a specific case. In that aniline forms a 3:1 aminate with decaborane while N-methylaniline and N,N-dimethylaniline only form a 2:1 aminate seems to indicate that steric effects of the amine predominates in the determination of the number of ligands which may bond.

All the aminates decomposed at elevated temperatures to form yellow viscous liquids which formed yellow translucent glasses on cooling. They dissolved only in very polar solvents such as dimethylformamide and were found to be highly diamagnetic. Only the N-methylaniline and N,N-dimethylaniline decaborane aminates could be degraded sufficiently by mineral acids to permit the recovery of amine and decaborane for qualitative tests.

Microfilm $2.00; Xerox $6.40. 133 pages.

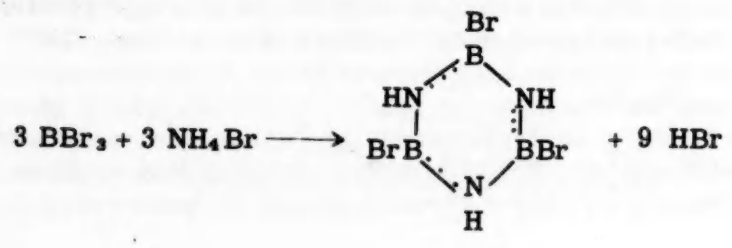
A STUDY OF SOME BORAZOLE DERIVATIVES.

(L. C. Card No. Mic 59-5287)

Phillip Gerhard Thompson, Ph.D.
Cornell University, 1959

This thesis describes the preparation of B-tribromoborazole, the effect of substituents on the borazole ring as shown by various physical and chemical properties, and the formation of B-trialkylborazoles from the corresponding B-tribromoborazoles.

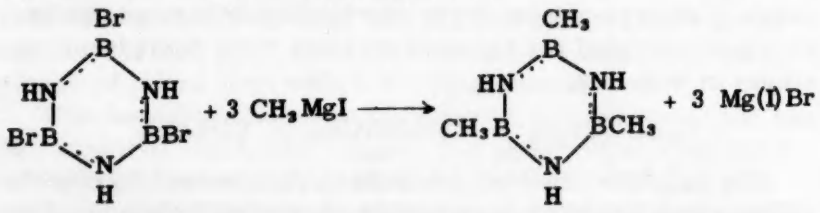
Boron tribromide reacts with ammonium bromide to yield B-tribromoborazole according to the following equation:



The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

B-tribromoborazole is a colorless, crystalline solid (m.p., 128°C), easily sublimed in high vacuum and soluble in a variety of the inert, non-polar organic solvents. It is very readily hydrolyzed, but is stable at room temperature in the absence of moisture. Thermal decomposition studies show that B-tribromoborazole is more unstable thermally than B-trichloroborazole, liberating HBr above 100°C. The infrared spectrum and powder x-ray pattern of B-tribromoborazole are presented.

B-tribromoborazole reacts in ethereal solution with methyl magnesium iodide to yield B-trimethylborazole according to the following equation:



Boron tribromide reacts with aniline in benzene solution forming the addition compound, $C_6H_5NH_2 \cdot BBr_3$, which liberates two moles of HBr upon heating and yields B-tribromo-N-triphenylborazole.

$$BBr_3 + C_6H_5NH_2 \xrightarrow{0^\circ} C_6H_5NH_2 \cdot BBr_3$$

$$3\ C_6H_5NH_2 \cdot BBr_3 \xrightarrow{\Delta} B_3Br_3N_3(C_6H_5)_3 + 6\ HBr$$

This compound reacts with methyl magnesium iodide to give B-trimethyl-N-triphenylborazole.

The preparation of boron tribromide from bromine and boron or boron carbide is also discussed and various improvements in the experimental procedure presented.

Microfilm $2.00; Xerox $5.00. 96 pages.

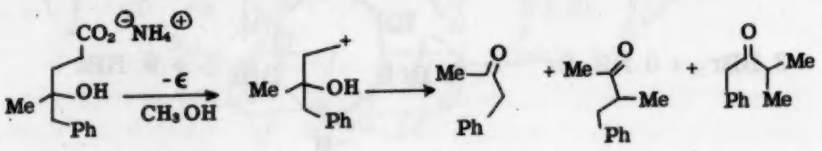
CHEMISTRY, ORGANIC

A SCRUTINY OF THE ANOMALOUS BEHAVIOR OF ELECTROLYTICALLY GENERATED ALKYL RADICALS: PART I. THE MECHANISM OF THE C_β-C_γ CLEAVAGE OF γ-HYDROXY ACIDS DURING KOLBE ELECTROLYSIS. PART II. THE ANODIC OXIDATION OF CARBON RADICALS TO CARBONIUM IONS.

(L. C. Card No. Mic 59-4488)

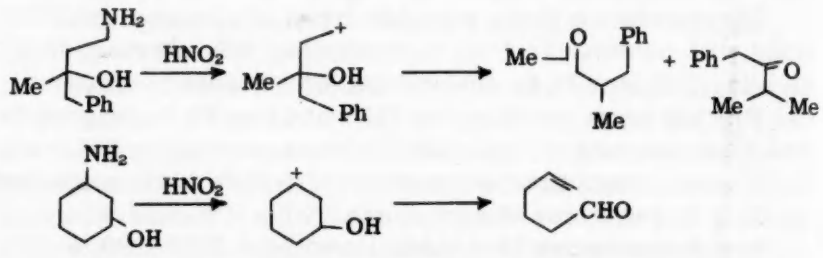
Nathan Louis Bauld, Ph.D.
University of Illinois, 1959

The mechanism of the novel C_β-C_γ cleavage reaction of γ-hydroxy acids during Kolbe electrolysis reported recently by Corey and Sauers has been explored using a simple aliphatic system and found to involve an intermediate carbonium ion which, aside from the cleavage reaction, may suffer rearrangement to afford other ketones, the



blend of the two observed reactions being prominently contingent on temperature. At 15° the major product is the cleavage ketone, methyl benzyl ketone, whereas at 64° the rearrangement predominates. No conventional radical products are perceived.

It is deduced, by analogy to reactions of authentic radicals, that these manifestations cannot be fomented by normal radicals. Further, it is shown that the observed reactions are just those to be anticipated from a carbonium ion intermediate, by comparison with the demeanor of the relavant carbonium ion generated by nitrous acid deamination



of the appropriate amine and with the generalized concept of carbonium ion behavior.

In order to substantiate the postulate of anodic oxidation of carbon radicals to carbonium ions some systems were scrutinized wherein quantitative product distributions could be ascertained and compared with the distributions emanating from authenticated carbonium ion reactions.

The electrolysis of Δ^5-cholestene-3β-carboxylic acid in methanol adduced that the intermediate cholesteryl radical could be oxidized from either the β(60%) or α(40%) side. The β-oxidized product was 85 ± 15% of 6β-methoxy-3:5-cyclocholestane, in satisfactory agreement with the results from the solvolysis of cholesteryl tosylate which affords 90% of the cyclo ether. Alpha oxidation occurred with concomitant or subsequent 4β-H migration, ultimately producing the two possible allylic ethers analogous to the behavior of epicholesteryl tosylate.

The electrolysis of cyclobutane carboxylic acid in water gave unambiguous agreement with quantitative expectation, based on a comparison of the alcohol mixtures from the electrolysis and from the deamination of cyclobutyl amine, respectively. The dispensation of cyclobutanol and cyclopropyl carbinol in each of these reactions is given below as obtained from vapor phase chromatographic analysis.

	Deamination (IR analysis)	Deamination (VPC analysis)	Electrolysis (VPC analysis)
Cyclobutanol	51%	60%	53%
Cyclopropyl carbinol	49	40	47

This verifies irrefutably the intervention of carbonium ions under at least some electrolytic conditions.

A review of some previously anomalous reactions which may be interpreted in terms of this reaction mode as well as a survey of factors influencing the prevalence of Kolbe radical reactions versus anodic oxidation is included.

Microfilm $2.00; Xerox $5.40. 109 pages.

THE SYNTHESIS AND REACTIONS OF BENZ(C)ACRIDINE DERIVATIVES.

(L. C. Card No. Mic 59-4370)

Vernon Lee Bell, Ph.D.
The University of Nebraska, 1958

Adviser: Norman H. Cromwell

Benz(c)acridines have been shown to possess varying degrees of carcinogenic activity, in contrast to the tumor-inhibiting properties of the benz(a)acridines. The purpose of this investigation was to synthesize several new benz(c)-acridines, together with derivatives of the intermediate dihydrobenz(c)acridines, to be tested for carcinogenic activity.

The synthesis of the versatile starting material, 4,4-dimethyl-1-tetralone (IV), was improved by two modifications, thus resulting in a considerable simplification and a greater yield.

5,6-Dihydrobenz(c)acridine (VIII) was prepared by two procedures: the existing Pfitzinger-Borsche reaction and a new reaction leading to the benz(c)acridine skeleton from 2-(o-nitrobenzal)-1-tetralone (VI). The aromatic benz(c)-acridine (X) was obtained, not only by dehydrogenation of VIII, but also by a unique rearrangement consequent to the reduction of a naphthol derivative, 2-(α-N-morpholino-o-nitrobenzyl)-1-naphthol (IX).

The same two routes were utilized in preparing 5,5-dimethyl-5,6-dihydrobenz(c)acridine (XIV). Bromination of XIV with N-bromosuccinimide afforded a very useful reactive halogen compound, 6-bromo-5,5-dimethyl-5,6-dihydrobenz(c)acridine (XV). This compound was used to prepare a variety of 5,5-dimethyl-5,6-dihydrobenz(c)acridine derivatives by replacement of the bromine atom with alkoxy, hydroxy and secondary amino groups. Oxidation of 5,5-dimethyl-6-hydroxy-5,6-dihydrobenz(c)acridine (XXII) produced 5,5-dimethyl-6-keto-5,6-dihydrobenz(c)acridine (XXIII).

A thermal reaction, proceeding via a Wagner-type rearrangement, was developed whereby the bromo compound XV was dehydrobrominated and rearranged to give 5,6-dimethylbenz(c)acridine (XVII). This compound should prove interesting for carcinogenic testing, since methyl groups have been placed on both carbon atoms of the so-called "K region" of carcinogenic theory. Methods of carrying out this rearrangement were studied, including silver and amine catalysis in solution.

Using the same procedures employed for preparing 5,6-dimethylbenz(c)acridine (XVII), a series of 5,5-dimethyl-5,6-dihydrobenz(c)acridine derivatives and 5,6-dimethylbenz(c)acridines, possessing chlorine atoms in the 9-, 10- and 11- positions of the benz(c)acridine skeleton, were prepared in good yields.

An addition product of phenyl magnesium bromide to 5,5-dimethyl-6-keto-5,6-dihydrobenz(c)acridine (XXIII) was prepared and found to resemble similar products reported in the literature. The infrared and ultraviolet spectra of this addition product were determined and studied in an effort to determine the nature of the product.

The ultraviolet spectra of all intermediate benzal tetralones, dihydrobenz(c)acridines and benz(c)acridines were determined and found to exhibit characteristic features useful in determining the degree of aromatization of the products. Microfilm $2.00; Xerox $4.80. 94 pages.

THE STRUCTURE OF LUMICOLCHICINE. ORGANIC MOLECULAR COMPLEXES.

(L. C. Card No. Mic 59-4763)

Richard L. Brandon, Ph.D.
The University of Texas, 1958

Supervisor: Professor P. D. Gardner

A number of reactions of β- and γ-lumicolchicine and its derivatives were studied. In order to demonstrate that the two isomers differ only in the configuration of ring D, the methanesulfonate derivatives of tetrahydro β- and tetrahydro γ-lumicolchicine were solvolysed. It was expected that rearrangement to a tropolonoid structure would result with the product of the solvolysis being identical in the β- and γ-series. Solvolysis did not result in rearrangement, but in the formation of carbonyl derivatives (in both the β- and γ-series) which are believed to be formed via group participation of the methoxyl group with the carbonium ion formed during solvolysis. Reduction of these carbonyl derivatives, formation of the methanesulfonate derivatives and subsequent solvolysis did not result in rearrangement to a tropolonoid structure.

The stereochemical assignment for β- and γ-lumicolchicine was made on the basis of spectral evidence derived from the tetrahydro derivatives and application of the von Awers-Skita rule. It was concluded that in β-lumicolchicine the fusion of the C-D rings is such that ring D is cis to the acetamido function while the γ-isomer has the trans relationship.

The association constants for the interaction of a number of substituted naphthalenes with picric acid and 1,3,5-trinitrobenzene are reported. The association constants were determined spectrophotometrically and the values compared with values obtained using the partition method. The consistent difference in the values obtained by the two methods is discussed in the light of the charge transfer theory of complex formation. It is noted that the difference of the two methods may be due to the superimposition of "contact" charge transfer absorption or of absorption due to solvent perturbation upon the charge transfer absorption band. Microfilm $2.00; Xerox $5.20. 100 pages.

1. SYNTHESIS IN THE THIENO[3,2-b]PYRROLE SERIES. 2. THE ACTION OF SULFUR ON INDOLE.

(L. C. Card No. Mic 59-4497)

Wayne Rex Carpenter, Ph.D.
University of Illinois, 1959

I

Several derivatives of thieno[3,2-b]pyrrole and 2H,3H-thieno[3,2-b]pyrrol-3-one have been synthesized.

Three main products are produced in the base-catalyzed carbethoxylation of 2H,3H-thieno[3,2-b]pyrrol-3-one in refluxing diethyl carbonate. These products are dimeric enols whose structures correspond to (1) the dimer of 2-carbethoxy-3-hydroxythieno[3,2-b]pyrrole, (2) the dimer of 2,N-dicarbethoxy-3-hydroxythieno[3,2-b]pyrrole, and

(3) the mixed dimer of 2-carbethoxy-3-hydroxythieno-[3,2-b]pyrrole and 2,N-dicarbethoxy-3-hydroxythieno-[3,2-b]pyrrole.

The type of bonding between the monomeric units of the three dimers is investigated. Several facts are discovered which eliminate many possible types of dimerization. It is postulated that the types of bonding between the monomeric units of all three compounds are identical and that they involve hydrogen bonding between the hydroxyl groups and the carbethoxyl groups of the two units. Rapid equilibria are found to exist between the monomers and the dimers. However, the equilibria lie far toward the formation of the dimers.

Chemically, all three dimeric compounds usually behave as if they were monomeric, stable enols. The dimeric compounds are converted to monomeric, O-methyl derivatives by diazomethane. The stable sodium salts of 2-carbethoxy-3-hydroxythieno[3,2-b]pyrrole and 2,N-dicarbethoxy-3-hydroxythieno[3,2-b]pyrrole are easily converted to the corresponding O-acetyl derivatives by treatment with acetic anhydride.

Under certain conditions the dimer of 2-carbethoxy-3-hydroxythieno[3,2-b]pyrrole behaves as a β-keto ester. The reaction of the dimer of 2-carbethoxy-3-hydroxythieno[3,2-b]pyrrole with methyl iodide and potassium carbonate in acetone produces 2-methyl-2-carbethoxy-2H,3H-thieno[3,2-b]pyrrol-3-one and 2,N-dimethyl-2-carbethoxy-2H,3H-thieno[3,2-b]pyrrol-3-one.

Reduction of 2-carbethoxy-3-methoxythieno[3,2-b]pyrrole and the dimer of 2-carbethoxy-3-hydroxythieno[3,2-b]-pyrrole with lithium aluminum hydride produces 2-methyl-3-methoxythieno[3,2-b]pyrrole and 2-methyl-2H,3H-thieno-[3,2-b]pyrrol-3-one, respectively. These results are unusual in that a carbethoxyl group is converted to a methyl group by lithium aluminum hydride.

2-Carbethoxy-3-acetoxythieno[3,2-b]pyrrole is converted smoothly to an oxalyl derivative by means of oxalyl chloride. The position of attachment of the oxalyl group has not been determined.

II

The action of sulfur on indole at 145° has been found to produce a high-melting compound having the empirical formula $C_{16}H_{10}N_2S_4$. Dimethylformamide is an excellent solvent for the reaction, in which yields as high as 59 per cent are obtained. The best yields in other solvents lie below 15 per cent.

The most probable structure for the compound has been shown to be 3,3'-diindolyl-2,2'-tetrasulfide on the basis of three reactions.

(1) Raney-nickel desulfurization produces 3,3'-diindolyl.

(2) Reduction with sodium borohydride removes two of the four sulfur atoms.

(3) Reduction with lithium aluminum hydride, followed by treatment of the reduction product with methyl iodide, produces 2,2'-dithiomethyl-3,3'-diindolyl. Since this reaction and the previous reaction with sodium borohydride remove two sulfur atoms in the process of reduction, the four sulfur atoms in the original compound must be arranged in a tetrasulfide linkage. Whether this linkage is linear or branched has not been determined.

Another compound, 3,3'-diindolyl disulfide, is produced by the action of sulfur on excess indole. The facile conversion of this compound to 3,3'-diindolyl-2,2'-tetrasulfide by the action of sulfur indicates that it is an intermediate in the formation of 3,3'-diindolyl-2,2'-tetrasulfide from indole and sulfur. Similarly, 3,3'-diindolyl is shown not to be an intermediate because of its non-conversion to 3,3'-diindolyl-2,2'-tetrasulfide under identical conditions.

Microfilm $2.00; Xerox $4.80. 92 pages.

STRUCTURE DETERMINATION OF A COMPOUND IN THE REACTION OF ACETOPHENONE AND NITRIC ACID.

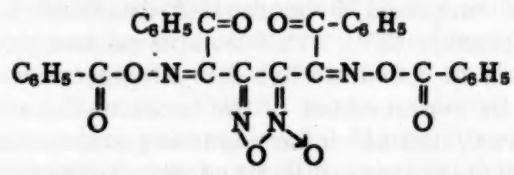
(L. C. Card No. Mic 59-4192)

Marguerite Shue-wen Chang, Ph.D.
Tulane University, 1959

Chairman: J. H. Boyer

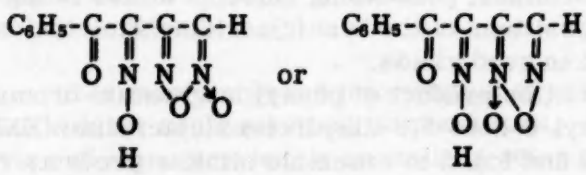
A product, $C_{32}H_{20}N_4O_8$, from acetophenone and nitric acid was first prepared in 1887. Its empirical formula, $C_8H_5NO_2$, suggested that it was related to dibenzoylfuroxane, $C_{16}H_{10}N_2O_4$, another product of the reaction and accounted for the incorrect literature references to it as an "isomer" of dibenzoylfuroxane.

The material is now identified as the dibenzoate ester of bis-(benzoylformaldoximino)-furoxane (DBFF):



This identification is based upon molecular weight and spectrophotometric measurements together with investigations on chemical degradation.

Mild hydrolysis as well as hydrogenation gives two moles of benzoic acid. More drastic conditions of hydrolysis as well as oxidation afforded four moles of benzoic acid. In its reaction with 2,4-dinitrophenylhydrazine the 2,4-dinitrophenylhydrazone of benzaldehyde was obtained, whereas the use of phenylhydrazine led to the formation of benzoic acid hydrazide and the use of hydrazine afforded dibenzoyl hydrazine. Apparently one of the two side chains attached to the furoxane ring was cleaved by hydroxylamine in alkaline solution (but not in neutral solution) with the formation of 3(or 4) -benzoylformaldoximinofuroxane.



The structure of the latter compound was supported by spectrophotometric measurements, oxidation to benzoic acid and elemental analysis.

Pyrolysis of $C_{32}H_{20}N_4O_8$ under vacuum led to a mixture of solids, one of which was thought to be benzoic anhydride which was hydrolyzed to benzoic acid.

Correlation of all the data made it possible to assign

the structure of the dibenzoate ester of bis-(benzoyl-formaldoximino)-furoxane to $C_{32}H_{20}N_4O_8$.

Microfilm $2.00; Xerox $3.00. 60 pages.

THE SYNTHESIS AND REACTIONS OF SOME 4-SUBSTITUTED QUINUCLIDINES.

(L. C. Card No. Mic 59-4606)

Ernest A. Coleman, Ph.D.
University of Pennsylvania, 1959

Supervisor: Frederick V. Brutcher

The synthesis, proof of structure and preparation of derivatives of 4-quinuclidinol was undertaken because the compound was desired for theoretical studies both chemical and medicinal, and since the synthesis itself was a challenge.

The synthesis started with ethyl (1-benzoyl-4-hydroxy-4-piperidyl)-acetate prepared by the method of S. M. McElvain and R. E. McMahon (J. Am. Chem. Soc., 71 901 (1949) starting from ammonia and ethyl acrylate to form Di-(β-carbethoxyethyl)-amine which was converted to n-benzoyl-di-(β-carbethoxyethyl)-amine that cyclized via a Dieckmann reaction to 1-benzoyl-3-carbethoxy-4-piperidone. This β-ketoester underwent hydrolysis and decarboxylation to 4-piperidone hydrochloride which was converted to 1-benzoyl-4-piperidone that reacted with ethyl bromoacetate in a Reformatsky reaction to yield the starting compound, ethyl (-benzoyl-4-hydroxy-4-piperidyl)-acetate which was crystallized for the first time in this work. This ester was reduced in 80% yield with lithium aluminum hydride to 1-benzyl-4(β-4-(β-hydroxyethyl)4-piperidinol. This diol reacted in chloroform solution with p-toluenesulfonyl chloride in the presence of potassium carbonate to yield 1-benzyl-4-hydroxyquinuclidinum p-toluenesulfonate in 36% yield which was converted to the bromide, chloride, hydroxide, or iodide by an ion exchange step. 4-Quinuclidinol hydrobromide was formed from 1-benzyl-4-hydroxyquinuclidinum bromide by hydrogenolysis using a palladium black catalysis in 50% ethanol. Pure 4-quinuclidinol was obtained from the hydrobromide by neutralization with base or by ion exchange. The last three steps proceeded in nearly quantitative yield.

4-Quinuclidinol was converted to 4-quinuclidinol benzoate and 1-benzyl-4-hydroxyquinuclidinum benzoate chloride for infrared studies. Some evidence relating to the direct field effect was obtained from this study.

The reaction of a p-toluenesulfonate ester with an amine was used for the first time to synthesize a simple quinuclidine and the general nature of this reaction was shown by application and a literature survey.

The structure of 4-quinuclidinol was proven by elemental analysis, molecular weight studies and nuclear magnetic resonance spectra of it as well as method of synthesis, and elemental analysis and molecular weight studies of derivatives of 4-quinuclidinol and intermediates in the synthesis of 4-quinuclidinol.

Microfilm $2.00; Xerox $5.40. 108 pages.

THE EFFECT OF ALCOHOLS ON THE KINETICS AND MECHANISM OF THE AMINOLYSIS OF ALKYL FORMATES.

(L. C. Card No. Mic 59-4607)

John S. Conte, Ph.D.
University of Pennsylvania, 1959

Supervisors: Dr. A. R. Day - Dr. J. G. Miller

The kinetics and mechanism of the ammonolysis and the aminolysis of esters have been studied for many years to determine the effects of structure and solvent on the reaction rate and in most cases it has been shown that aminolysis follows second-order kinetics. However, work done at the University of Pennsylvania in recent years has shown that the aminolysis of esters gives a crossover in kinetic order, going from second- (excess amine) to third-(excess ester) order kinetics.

The present study of the kinetics of aminolysis was undertaken with four objectives in mind:

1. To observe whether a crossover in kinetic order occurs when varying the concentration of the reactants.
2. To determine the effect of the alcohol on the rate and mechanism of the reaction.
3. To elucidate the mechanism of aminolysis.
4. To compare the findings for alkyl formates with the recorded results of other workers.

The reaction of n-propyl and isopropyl formate with n-butylamine was studied in the alcohols corresponding to the alkoxyl groups of the esters in 2,5,8 and 10M alcohol concentration, using benzene as a diluent. The reaction of n-propyl formate with piperidine was studied in 5,8 and 10M alcohol (1-propanol) concentration. The concentration of the ester and amine was varied from 0.100 to 0.400M, each being varied within this range. This was done to determine the catalytic effect of the alcohol and the effect of varying the concentration of the reactants.

The data were collected and applied to the second, third and five-halves order rate equations. In all cases the data appear to fit the third-order rate equation best, the rate being second-order in amine and first-order in ester. There also was observed a definite catalytic effect by the alcohol.

Since the rate appeared to be third-order and because other aminolyses show second-order kinetics, it was necessary to explore the possibility that there is more than one reaction path leading to the final products. These paths would differ in that they involve different reactant species derived from amine.

The following mechanisms appear to be possible for the aminolysis of these esters.

1. Simple attack of ester by amine.
2. Pre-equilibrium of amine and ester followed by attack by alkoxide ion upon the complex formed.
3. Simple attack by amide ion on the ester.
4. Pre-equilibrium of amine and ester followed by attack by amine on the complex formed.
5. A pre-equilibrium which forms complex between alcohol and amine, followed by attack on the ester by this complex.

All of the above mechanisms were applied to the data and it seems that none of these specific mechanisms applies singly to the aminolysis of these formate esters. It was therefore concluded that several of these mechanisms are in effect concurrently.

A simultaneous combination of all the above mechanisms was applied to the data and this combination seems to fit the aminolysis of these formate esters. However, in it the only competing mechanisms of importance are the mechanisms in which an amine molecule reacts with a complex of ester and amine (4) and in which a complex of alcohol and amine reacts with ester (5).

As far as the chosen mechanisms are concerned, it would appear that in the absence of added electrolyte the amount of quaternary ammonium salt or, in fact, any other salt, is very low, which is in agreement with the observations as well as the mechanisms.

Microfilm $2.00; Xerox $5.40. 108 pages.

A CONTRIBUTION TO THE CHEMISTRY OF FUROXANES AND ψ-DINITROSO AROMATIC COMPOUNDS: REDUCTION WITH SODIUM BOROHYDRIDE AND OXIDATION WITH PEROXYTRIFLUOROACETIC ACID.

(L. C. Card No. Mic 59-4194)

Samuel Edward Ellzey, Jr., Ph.D.
Tulane University, 1959

Chairman: J. H. Boyer

A resonance hybrid ψ-dinitroso structure has been previously suggested for those compounds in which NO groups are attached to two carbon atoms which are part of an aromatic ring system (although m-dinitrosobenzene appeared to be a true nitroso compound). When the two NO groups are joined to adjacent carbon atoms which are not part of an aromatic ring system, the cyclic furoxane structure has previously been shown to be correct.

By other workers it was shown that reaction of disubstituted furoxanes with lithium aluminum hydride brought about a reductive fission of the C-C bond of the furoxane ring and primary amines were isolated as reaction products. Neither monosubstituted furoxanes nor ψ-o-dinitrosoaromatic compounds were cleaved by lithium aluminum hydride but the corresponding diamines were formed in each case.

An investigation of the behavior of furoxanes and ψ-o-dinitrosoaromatic compounds with sodium borohydride (SBH) and with peroxytrifluoroacetic acid was undertaken.

Attempted preparation of m-dinitrosobenzene by published procedures was unsuccessful. A solid, m.p. 148.5-148.8°, was isolated during the attempted preparation from m-dinitrobenzene. An adequate empirical formula could not be assigned to this compound on the basis of its elemental analysis.

The SBH reduction of ψ-o-dinitrosobenzene, its para-isomer and 4-methyl-ψ-1, 2-dinitrosobenzene proceeded smoothly with the formation of the corresponding dioximes. Reaction of 3, 5-dinitro-ψ-1, 2-dinitrosobenzene with SBH apparently brought about salt formation and alkaline decomposition.

ψ-1, 2-Dinitrosonaphthalene, ψ-9, 10-dinitrosophenanthrene and 3, 6-diphenyl-ψ-4, 5-dinitrosopyridazine were apparently reduced by SBH to the corresponding dioximes which subsequently underwent dehydration and formed furazanes.

The transformation of diphenyl furoxane into β-(syn-)-benzil dioxime was accomplished with SBH, while low yields of anti-dioximes resulted upon SBH reduction of cyclohexenfuroxane and dimethyl furoxane. The reduction of dibenzoyl furoxane with SBH at room temperature apparently involved only the two carbonyl groups; the product was tentatively assigned the structure of bis-(phenylhydroxymethyl)furoxane. Reaction of the reduction product with dilute sodium hydroxide at room temperature gave benzaldehyde.

High yields of azoxybenzene were obtained by reaction of SBH with either nitrosobenzene or β-phenylhydroxylamine. p-Nitrosophenol was reduced with SBH in sodium hydroxide solution to p-aminophenol.

Cyclohexanone oxime yielded only a trace of cyclohexylamine when treated with SBH in the presence of lithium bromide.

The combination of 90% hydrogen peroxide with trifluoroacetic acid brought about the transformation of ψ-o-dinitrosobenzene and 4-methyl-ψ-1, 2-dinitrosobenzene into the corresponding dinitro compounds in low yields. The per-acid or chromic acid oxidized ψ-p-dinitrosobenzene to p-dinitrobenzene in high yield.

3, 5-Dinitro-ψ-1, 2-dinitrosobenzene, ψ-1, 2-dinitrosonaphthalene and ψ-9, 10-dinitrosophenanthrene were recovered unchanged upon treatment with peroxytrifluoroacetic acid.

Attempted oxidation of diphenyl furoxane with the per-acid was unsuccessful.

From the reaction of nitrosobenzene with peroxytrifluoroacetic acid was obtained nitrobenzene and p-nitroso-N, N-diphenylhydroxylamine.

Microfilm $2.00; Xerox $4.80. 92 pages.

AN INVESTIGATION OF THE ALKALOIDS OF ALSTONIA MUELLERIANA.

(L. C. Card No. Mic 59-4911)

Robert Edward Gilman, Ph.D.
University of Michigan, 1959

The purpose of this investigation was to examine the bark of Alstonia muelleriana for alkaloid content and to do structural work on any uncharacterized alkaloids that were found.

This examination resulted in the isolation of four apparently new alkaloids which were designated Alkaloids A, B, C, and D in order of their isolation. Their formulas and melting points are listed below.

Alkaloid	Formula	m.p.
A	$C_{21}H_{24-26}O_2N_2$	322-325° (dec.) (vac.)
B	$C_{40}H_{50}O_4N_4$	235-270° (dec.) (vac.)
C	$C_{19-20}H_{20}O_3N_2$	168-169°
D	$C_{20}H_{22}O_2N_2$	172-173°

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

Only Alkaloid B, the major alkaloid, was isolated in sufficient quantity to allow structural work to be done.

The ultraviolet spectrum was very similar to that of alkaloids which contain the indole moiety. The infrared spectrum showed two bands in the carbonyl region.

Analytical results indicated that the crystalline base contained one methylimino and one methoxyl group. The formation of the dihydrochloride, dioxalate, and dimethiodide derivatives indicated that two basic and two nonbasic nitrogens were present. Furthermore, the formation of the dimethiodide derivative indicated that the two basic nitrogens were tertiary.

The methoxyl group was removed by alkaline hydrolysis. The crude product was purified as the dihydrochloride which analyzed for $C_{38}H_{47}O_2N_4 \cdot COOH \cdot 2HCl$. Treatment of this compound with diazomethane gave a crude ester which could not be purified. Examination of its infrared spectrum indicated it was not Alkaloid B. Therefore, something more profound than the simple hydrolysis of a carbomethoxyl group must have taken place.

The alkaloid was unchanged by mild catalytic hydrogenation or by treatment with sodium borohydride. Reduction with lithium aluminum hydride gave a crystalline product which showed no absorption in the carbonyl region of the infrared spectrum. Analysis of this compound and its salts suggested a formula of $C_{39}H_{48}O_3N_4$ for the free base. Treatment with acetic anhydride in refluxing pyridine yielded what appeared to be the diacetyl derivative, $C_{39}H_{48}O_3N_4 \cdot 2COCH_3$. An acetyl determination, however, indicated the presence of only one acetyl group.

A variety of degradation reactions were run on the alkaloid in an effort to learn something about its basic ring structure. Selenium dehydrogenation yielded two crystalline products. The first was obtained from dehydrogenation at atmospheric pressure and was purified as its picrate. The ultraviolet spectrum of the crude free base suggested the presence of the β-carboline group. Good analytical results could not be obtained since the yield was extremely low. The second product was obtained by selenium dehydrogenation of the alkaloid in an evacuated system. A crystalline product was isolated which could not be converted to a picrate derivate. Analysis indicated a formula of $C_{21}H_{26}ON_2$. The ultraviolet spectrum suggested the presence of an indole group, while the infrared spectrum suggested the presence of an amide group. Since this product was also obtained in very low yield, structural work could not be done on it.

All other degradation reactions failed to yield crystalline products. Microfilm $2.00; Xerox $6.20. 129 pages.

PYRROLENINES AND THEIR DERIVATIVES FROM THE REDUCTION OF GAMMA-NITRO KETONES.

(L. C. Card No. Mic 59-3519)

Ramsis Gobran, Ph.D.
University of Southern California, 1959

Chairman: Professor Kloetzel

Slow hydrogenation of 4-methyl-4-nitro-3-phenyl-1-(4-pyridyl)-1-pentanone (I) over four-month-old Raney nickel yielded 2,2-dimethyl-3-phenyl-5-(4-pyridyl)-pyrrolidine (II). On the other hand, hydrogenation of I in presence of one-week-old Raney nickel was quite fast and afforded a mixture of the pyrrolidine II, the delta-1-pyrroline, 5,5-dimethyl-4-phenyl-2-(4-pyridyl)-pyrroline (III), and an oxygenated compound, $C_{17}H_{18}N_2O$, (IV).

Hydrazine reduction of 4-methyl-4-nitro-3-phenyl-1-(4-pyridyl)-1-pentanone (I) in the presence of Raney nickel also was found to depend on the age of the catalyst. A freshly prepared sample of Raney nickel furnished an almost quantitative yield of III. As the catalyst aged, the amount of pyrroline decreased in favor of the formation of the oxygen-containing compound IV. Hydrazine in the presence of Raney nickel which had been prepared six months earlier effected the reduction of I to the oxygen-containing compound IV and the pyrroline III, the latter being present as a minor product. Consistently good yields of the oxygenated compound IV were obtained from the reduction of I by hydrazine in the presence of stabilized Raney nickel.

The reduction of 4-methyl-4-nitro-3-phenyl-1-(3-pyridyl)-1-pentanone (V) has been reported by Chubb to yield an oxygen-containing compound, $C_{17}H_{18}N_2O$, (VI).

The four possible structures which represent the oxygen-containing compound VI; the hydroxypyrroline VIa, the nitrone VIb, the oxazine VIc, and the oxazoline VId have been considered. In the case of the oxygen-containing compound IV, only three structures are possible: the hydroxypyrroline IVa, the nitrone IVb, and the oxazine IVc.

On the basis of Zerewitinoff analyses and infrared spectra of IV and VI, the possibility of the hydroxypyrrolines IVa and VIa has been eliminated.

The oxazine structures IVc and VIc were shown not to represent the oxygen-containing compounds IV and VI through reduction of IV and VI to the respective hydroxylamines, followed by reoxidation to the original oxygenated compounds.

The oxazoline structure VId was eliminated, since nitric acid oxidation of VI afforded nicotinic acid nitrate.

The oxygen-containing compound IV was established beyond any doubt to have the nitrone structure IVb. This was deduced from its reactions and from the reduction of IV to the pyrrolidine II.

Parallel reactions also were effected to show the similarity of VI to IV, and to prove its structure to be that of the nitrone VIb.

The nitrones IVb and VIb were found to have similar infrared absorption spectra and did not form addition products. When IVb and VIb were treated with acetic anhydride or with benzoyl chloride, a dehydration occurred. The dehydration products were assigned the pyrrolenine structures VII and VIII, respectively.

Phosphorus trichloride reacted with the nitrones IVb and VIb to give mixtures of the corresponding pyrroline and pyrrolenine. From a consideration of the products obtained, a mechanism was suggested for this reaction. Evidence in favor of this mechanism was secured through the reaction of IVb and VIb with phosphorus oxychloride, which yielded the corresponding pyrrolenines exclusively. When triphenylphosphine also was employed to effect the reduction of IVb, the product predicted from the proposed mechanism, the pyrroline III, was indeed obtained.

Attempts to prepare the pyrrolenine, 5,5-dimethyl-4-phenyl-2-(4-pyridyl)-pyrrolenine (VII), by means of an independent route were unsuccessful. The structure of VII was established through its infrared spectrum and Zerewitinoff analysis, which indicated the absence of

active hydrogen. Unequivocal proof of the pyrrolenine structure was attained by means of its hydrogenation to the pyrrolidine II.

Microfilm $2.00; Xerox $5.60. 113 pages.

THE PREPARATION AND CYCLIZATION OF SOME SUBSTITUTED BENZYL-o-NITROPHENYLGLYOXALS AND THEIR QUINAZINE DERIVATIVES.

(L. C. Card No. Mic 59-3905)

Joseph Howard Graham, Ph.D.
Howard University, 1959

Chairman: R. Percy Barnes

The investigation by C. W. Muth et. al. [J.A.C.S., 79, 6500, (1957)] introduced to the chemical literature an instance of a cyclization involving a methylene group and a nitro group. This study centered around the formation of phenanthridine-5-oxides from 2-(2′-nitrophenyl)-phenylmethane derivatives. It was shown that the cyclization only took place in those cases in which the substituent on the methylene group was a meta directing group.

The above investigation lead us to the speculation that other compounds, apart from those that gave phenanthridine-5-oxides, might undergo a similar cyclization if they contained an active methylene group and a nitro group in sterically favorable positions. In an effort to confirm this speculation, the behavior of some substituted benzyl-o-nitrophenylglyoxals and their quinazine derivatives towards methanolic potassium hydroxide was studied.

2,4,6-Trimethylbenzyl-o-nitrophenylglyoxal was the only one of the 1,2-diketones used in this study that could be prepared by the alkaline rearrangement of the corresponding chalcone oxide. Dehydrochlorination of 1,3-diaryl-2-hydroxy-3-chloropropane-1-ones or the conversion of 1,3-diaryl-3-(N-methoxyamino)-propane-1-ones with alkali to α-amino chalcones followed by acid hydrolysis both failed to give workable yields of the desired diketones. The diketones were finally prepared by the acid hydrolysis of α-N-diethylamino chalcones.

The attempts to cyclize the diketones with methanolic potassium hydroxide were unsuccessful. It is strongly felt that this reaction as well as the attempts to prepare the diketones from the chalcone oxides resulted in a benzilic acid type rearrangement. The failure to cyclize the diketones to the predicted 2-aryl-3,4-diketoquinoline-N-oxides eliminated the most favorable route to a proof of structure by degrading these products to the known 2-arylquinolines. When the diketones were converted to their quinazine derivatives, they rapidly formed high melting yellow substances proposed to be the quinazine derivatives of 2-aryl-3,4-diketoquinoline-N-oxides when warmed with methanolic potassium hydroxide. Although an unequivocable proof of structure of the products was not made, the analytical data do indicate that the products result from an intra-molecular reaction. Microfilm $2.00; Xerox $3.00. 46 pages.

THE THERMAL DECOMPOSITION OF ARYL AZIDES.

(L. C. Card No. Mic 59-4920)

John Herbert Hall, Ph.D.
University of Michigan, 1959

The thermal decomposition of aryl azides was investigated to study the effect of structure on the rate of decomposition and on the products of the reaction. The investigation consisted of four phases.

The first phase involved the preparation of 1-azido-2-phenylnaphthalene, 2-(2'-azidophenyl)naphthalene, and 1-(2'-azidophenyl)naphthalene and their pyrolysis to benzocarbazoles. The first two were found to give exclusively 1,2-benzocarbazole, while the third gave only 3,4-benzocarbazole.

The second phase consisted of the preparation of 2-biphenylyl azide-3'-N^{15} and its pyrolysis to carbazole and nitrogen. The nitrogen evolved contained all of the nitrogen-15, indicating that the two terminal nitrogen atoms are lost during the decomposition and that the nitrogen atom attached to carbon is retained in the carbazole.

The third phase was the preparation of a series of substituted phenyl azides and o-azidobiphenyls for the study of the effect of substituents on the rate of decomposition. Rates of nitrogen evolution were measured. Some of the substituted phenyl azides gave more than one mole of nitrogen per mole of azide decomposed, making quantitative determination of the rate constants difficult. Qualitatively, it was found that meta substituents did not affect the rate significantly, while all para substituents increased the rate regardless of the electrical nature of the substituent. When the substituted o-azidobiphenyls were pyrolyzed in decalin solution, quantitatively one mole of nitrogen was obtained per mole of azide decomposed, allowing quantitative determination of first-order rate constants. As with the phenyl azides, substituents located meta to the azido group had little effect on the rate, while all para substituents increased the rate. The order of increasing rate for para substituents was hydrogen < nitro < methyl < bromo < methoxy. Enthalpies and entropies of activation were calculated. In the para-substituted group, the order of increasing enthalpy of activation was methoxy < bromo < methyl < hydrogen < nitro. The entropy of activation became more positive in the same order. The significance of these results is discussed in terms of their relation to a number of proposed mechanisms.

In the fourth phase, the dissociation constants of o-, m-, and p-azidobenzoic acids and o-, m-, and p-azidoanilines were measured. The azido group in any position enhanced the acidity of benzoic acid, but a m-azido group was more effective in increasing the acidity than was a p-azido group. The azido group in any position decreased the basicity of aniline, a m-azido group being more effective than a p-azido group. These results are interpreted to mean that the azido group is inductively electron-withdrawing, but that it may mesomerically donate electrons. The similarity of the azido group and the bromo group is noted.

Microfilm $2.00; Xerox $4.60. 87 pages.

STUDIES OF SOME HINDERED BORON COMPOUNDS.

(L. C. Card No. Mic 59-4517)

Richard Thomas Hawkins, Ph.D.
University of Illinois, 1959

A study has been made of some organoboron compounds containing boron-nitrogen and boron-oxygen bonds wherein the boron atom was sterically hindered by ortho methyl groups or the boron atom was placed in favorable juxtaposition to a basic amino function. Some of the organoboron compounds prepared exhibited uncommon stabilities and several showed unexpected properties.

A series of mesityl-substituted organoboron compounds was prepared: mesityleneboronic acid, its anhydride, dimesityleneborinic acid, its anhydride, and trimesitylboron. All attempts to nitrate mesityleneboronic and dimesityleneborinic acids were unsuccessful. However, trimesitylboron was nitrated successfully, an indication of the stability of the hindered triarylboron. Each ring of the trimesitylboron underwent dinitration at temperatures as low as -40°. The anhydride of mesityleneboronic acid was shown by molecular weight determinations to be a dimer, for which a four-membered boron-oxygen ring was proposed. Spectral evidence for the formation of a complex between mesityleneboronic anhydride and pyridine was noted. Dimesityleneborinic acid was not successfully dehydrated to its anhydride nor was the latter hydrated to the acid.

2-Mesityl-1,3-dihydro-2,1,3-benzoboradiazole, prepared from mesityleneboronic acid and o-phenylenediamine, was shown to be more resistant to cleavage by hydrochloric acid than was the 2-phenyl analog.

o-(N-Morpholinomethyl)benzeneboronic and o-(dimethylaminomethyl)benzeneboronic anhydrides were prepared from o-(bromomethyl)benzeneboronic anhydride and the corresponding amines. The favorable juxtaposition of the nitrogen functions to the boron atoms produced some unusual effects. The amino-anhydrides were amphoteric and formed quaternary salts; they were observed to form neither complexes with pyridine nor picrates. o-(Dimethylaminomethyl)benzeneboronic anhydride, a trimer, was observed to form a dihydrochloride. The formation of a dihydrochloride salt was interpreted to mean that one basic function was participating in internal complex formation and was thus unavailable for salt formation. o-(N-Morpholinomethyl)benzeneboronic anhydride was hydrated to the corresponding amino-boronic acid.

A new heterocyclic ring system containing boron was synthesized. 1,2,3,6-Tetrahydro-4,5,7,8-dibenzo-2,1,3-boradiazapentalene was prepared from o-(bromomethyl)-benzeneboronic anhydride and o-phenylenediamine. The heterocycle showed good resistance to hydrolytic cleavage and was readily oxidized.

Microfilm $2.00; Xerox $3.80. 66 pages.

A STUDY OF THE SYNTHESIS, REDUCTION AND INFRARED SPECTRA OF AROYLDIAZOACETIC ESTERS.

(L. C. Card No. Mic 59-4376)

Charles Harold Hayes, Ph.D.
The University of Nebraska, 1959

Adviser: James H. Looker

Methyl benzoyldiazoacetate and ten new substituted aroyldiazoacetic esters were prepared from the appropriate aroyl chloride and excess dry methyl diazoacetate. Methyl m-bromobenzoyldiazoacetate was prepared from both the corresponding aroyl bromide and chloride. A new acyldiazoacetic ester, methyl phenoxyacetyldiazoacetate, was prepared from phenoxyacetyl chloride and methyl diazoacetate. m-Bromobenzoyl bromide and excess dry ethyl diazoacetate gave the new compound ethyl m-bromobenzoyldiazoacetate. o-Chlorobenzoyl chloride, o-methoxybenzoyl chloride, m-methoxybenzoyl chloride, anisoyl chloride, and hydrocinnamoyl chloride and excess dry methyl diazoacetate gave oils tentatively identified as the corresponding diazo compound. alpha-Phenoxypropionyl chloride gave an oil when reacted with methyl diazoacetate containing a small amount of water.

The effect of the purity of the aroyl chloride and the water content of methyl diazoacetate on the successful preparation of crystalline methyl aroyldiazoacetates was established. By-products sometimes isolated from a reaction involving methyl diazoacetate containing water included either the carboxylic acid or anhydride, or both, corresponding to the aroyl chloride. alpha-Phenoxypropionyl chloride gave a small yield of the corresponding carboxylic acid under similar conditions. A mechanism was postulated to account for the appearance of nitrogen-free by-products.

Benzoyl bromide gave a substantial yield of benzoic acid when reacted with methyl diazoacetate and water. Methyl benzoate and methyl chloroacetate were identified as the principal products formed during the reaction of benzoyl chloride with dry methyl diazoacetate containing a large excess of methyl alcohol.

The only isolable product from the alkaline hydrolysis of methyl benzoyldiazoacetate was benzoic acid. Methyl benzoyldiazoacetate was found to be stable under the conditions occurring during steam distillation at reduced pressure, and was recovered quantitatively upon solution in 70% acetic acid.

Methyl benzoyldiazoacetate was hydrogenated over palladium on charcoal according to the procedure of Looker and Thatcher to give erythro-beta-phenylserine methyl ester hydrochloride. Alkaline hydrolysis of the product followed by paper chromatography of the total hydrolysate confirmed the stereospecificity of the hydrogenation. A refinement in procedure involved isolation of erythro-beta-phenylserine methyl ester as the neutral oxalate. Hydrogenation of methyl m-bromobenzoyldiazoacetate and m-chlorobenzoyldiazoacetate resulted in dehalogenation and isolation of the neutral oxalate of erythro-beta-phenylserine methyl ester. Gaseous ammonia converted the neutral oxalate to the free base with difficulty. Infrared spectra aided in the configurational assignments. Poisoning of the palladium catalyst prevented hydrogenation of methyl

o-iodobenzoyldiazoacetate. Methyl 3,5-dinitrobenzoyldiazoacetate and p-methanesulfonoxybenzoyldiazoacetate gave products tentatively identified as the corresponding erythro-beta-phenylserine methyl esters; nitro groups were reduced to amino groups. Methyl o-nitrobenzoyldiazoacetate gave an extremely high melting solid whose properties and infrared spectrum indicated the possible presence of a palladium chelate.

Hydrogenation of methyl benzoyldiazoacetate and 3,5-dinitrobenzoyldiazoacetate at one atmosphere proceeded in a stepwise manner; calculations based on hydrogen consumption indicated the corresponding alpha-aminoketones as intermediates. The curve of hydrogen consumption for methyl m-bromobenzoyldiazoacetate showed no stepwise hydrogen consumption. It was postulated that the stereospecific character of the hydrogenation of methyl benzoyldiazoacetate is the result of catalytic asymmetric induction by the groups about the asymmetric carbon in the corresponding alpha-aminoketone intermediate; the phenyl group exerts further steric control over substrate conformation. Predictions of the configuration of the predominate isomer resulting from catalytic hydrogenations of other systems were made.

Microfilm $3.55; Xerox $12.00. 273 pages.

FACTORS INFLUENCING THE DIRECTION OF OLEFIN FORMATION.

(L. C. Card No. Mic 59-4148)

James J. Hazdra, Ph.D.
Purdue University, 1959

Major Professor: Dr. R. A. Benkeser

Part I - Factors Influencing the Direction of Elimination in Ester Pyrolysis

The xanthate and acetate esters of a series of 1-alkylcyclohexanols, alkylcyclohexylcarbinols, and secondary alcohols of the general formula $R\text{-}CH_2\text{-}CHOH\text{-}CH_2\text{-}CH_3$ were pyrolyzed and the resulting olefin mixtures were analyzed by gas chromatography.

It was found that the Chugaev procedure and acetate pyrolysis give virtually identical olefin distributions. Evidence is presented to indicate that the direction of elimination is influenced by an interplay of three effects: (1) statistical factors, (2) relative thermodynamic stability of the olefin product, (3) steric effects, which either hinder or assist the formation of the cis, coplanar transition-state.

Part II - Abnormal Reactions of Olefinic Hydrocarbons

A series of sterically hindered olefins were prepared and ozonized. Upon ozonolysis of cyclohexylidene diphenylmethane, it was found that an epoxide was formed quantitatively. The formation of this epoxide is explained on the basis of steric hindrance.

Part III - Lithium-Amine Reductions of Aromatic Hydrocarbons

Representative types of mono-substituted alkylaromatic compounds were subjected to reduction by lithium in methyl- and in ethylamine in the presence of ethanol.

Evidence is presented to indicate that the saturated hydrocarbons formed are produced by a reduction of 3- and 4-alkylcyclohexenes. The 1-alkylcyclohexene which is formed does not undergo further reduction.

It has been demonstrated that one can obtain a mixture of 1-alkylcyclohexene and alkylcyclohexane or a mixture of the three possible alkylcyclohexenes depending on the conditions employed.

Microfilm $2.25; Xerox $8.00. 172 pages.

THE ORGANIC CHEMISTRY OF NITROXYL.

(L. C. Card No. Mic 59-4922)

George Ernest Hein, Ph.D.
University of Michigan, 1959

The chemistry of nitroxyl has been investigated both for possible synthetic use, especially for the conversion of alkyl halides to higher oxidation states by alkylating nitroxyl, and to learn more about this elusive compound.

As sources of nitroxyl benzenesulfonhydroxamic acid, $PhSO_2NHOH$, sodium nitrohydroxylamate, $Na_2N_2O_3$, and sodium nitrosyl, NaNO, were employed. The first compound gave none of the expected alkylation product of nitroxyl, benzaldoxime, on treatment with benzyl chloride. The only compounds isolated were benzyl phenyl sulfone and hydrolysis products of the halide. Similar results were obtained with other alkyl halides under a variety of conditions. Using sodium nitrohydroxylamate, it was possible to convert alkyl halides to oximes in yields up to 35%, but the reactions also gave hydrolysis products of the halide and base-catalyzed condensation and oxidation products of the oximes. The halides used included benzyl chloride, benzhydryl bromide, ethyl iodide, β-phenylethyl iodide and hydrocinnamyl iodide. The first two gave the largest yields of oxime condensation products, while only the last two gave significant yields of oximes. A thorough study of the reaction of sodium nitrohydroxylamate with hydrocinnamyl iodide showed that the highest conversions to oxime were obtained under strongly alkaline and non-aqueous conditions, which inhibited the decomposition of $Na_2N_2O_3$. The factors systematically investigated were reaction time, temperature, solvent, and alkalinity.

These results are interpreted on the basis of a mechanism which involves alkylation of nitroxyl precursors in all cases in which oximes are formed. Presumably, once formed, nitroxyl gives rise only to hyponitrous acid and nitrous oxide by dimerization and decomposition. The same type of mechanism, involving nitroxyl precursors, can be used to explain all reactions so far attributed to nitroxyl. Some qualitative observations on the Angeli reaction, the presumed addition of nitroxyl to aldehydes, support this view. Further evidence was obtained by studying the first-order decomposition of aqueous, aqueous ethanol and basic solutions of $Na_2N_2O_3$ by following

changes in their characteristic ultraviolet spectrum with time. The observed formation of oximes on attempted synthesis of alkyl nitrohydroxylamines is also compatible with this mechanism. Finally, simple oxime syntheses were achieved from alkyl halides by using nitroxyl precursors which had been stabilized by introduction of suitable blocking groups. Alkylation and subsequent hydrolysis of O-acetyl- and O-tetrahydropyranyl-benzenesulfonhydroxamic acids lead to oximes and N-alkyl hydroxylamines. The experimental conditions for these conversions are very mild.
Microfilm $2.00; Xerox $4.80. 94 pages.

BICYCLIC ESTERS OF 2-HYDROXYMETHYL-1,3-PROPANEDIOLS.

(L. C. Card No. Mic 59-3580)

Joseph Adrian Hoffman, Ph.D.
Rutgers University, 1959

Major Professor: R. A. Barnes

This study was undertaken to investigate the possibility of preparing bicyclic esters of 2-hydroxymethyl-1,3-propanediols and to observe their chemical behavior as compared to non-cyclic analogs.

The reaction of dilute solutions of trimethylolethane or trimethylolpropane with phosphorus trichloride in the presence of base proceeded to give, respectively, 1-methyl-3, 5,8-trioxa-4-phospha-bicyclo-[2,2,2]-octane and 1-ethyl-3, 5,8-trioxa-4-phospha-bicyclo-[2,2,2]-octane in 10% yield. Details of this reaction are discussed in addition to a modified and more convenient preparation of these compounds in 50% yield. Both of these derivatives are extremely hydroscopic, and apparently hydrolyze in water at room temperature to produce 98% of the corresponding primary phosphite and 2% free phosphorous acid. Either one of the bicyclic phosphite esters is readily converted to the corresponding phosphate or thionophosphate with suitable oxidizing agents. They will undergo the Arbuzov reaction only with the more reactive or ionic alkyl halides such as benzyl chloride or trityl chloride to produce the respective cyclic phosphonate. Possible mechanisms involved in this transformation are discussed.

A novel synthesis of 1-methyl-3,5,8-trioxa-4-trifluoromethyl-bicyclo-[2,2,2]-octane from trimethylolethane and trifluoroacetic acid is described. No reaction could be effected by boiling this ester with 10% sodium hydroxide, reduction with hydrogen and 10% palladium-on-charcoal or transesterification with benzoic acid. The possibility of using similar bicyclic ortho esters as a means of protecting carbonyl groups in alkaline reactions was considered unlikely since no convenient preparation of these derivatives has been found. Microfilm $2.00; Xerox $3.60. 65 pages.

THE TETRAZOLE-AZIDOAZOMETHINE EQUILIBRIUM.

(L. C. Card No. Mic 59-4196)

Harold Wayne Hyde, Ph.D.
Tulane University, 1959

Chairman: J. H. Boyer

The preparation of pyridotetrazoles through the reaction of hydrazoic acid with 2-halopyridines was investigated in some cases in which the pyridine nucleus also contained electron releasing groups. Most of the necessary 2-halopyridines were available from known reactions. The synthesis of 2-bromo-4-nitropyridine was achieved through the nitration of 2-bromopyridine-N-oxide. It was confirmed that the nitration at 130° gave only 2-bromo-4-nitropyridine-N-oxide as previously reported; however, nitration at 140° gave the desired product. That the formation of 2-bromo-4-nitropyridine involved initial nitration followed by reduction was indicated, since 2-bromo-4-nitropyridine-N-oxide was reduced under the conditions of the nitration.

The reaction of ammonia with 2,6-dibromopyridine was reported to give 2-amino-6-bromopyridine. The dibromopyridine was reported to be formed by the bromination of pyridine. It may also be prepared by the deamination of 3-amino-2,6-dibromopyridine. 2,6-Dichloropyridine may be prepared similarly.

The reaction of 3-amino-2-chloropyridine with hydrazoic acid gives rise to 8-aminopyridotetrazole only in the presence of a strong acid. Silver azide and hydrazoic acid were unreactive with 3-acetamido-2-chloropyridine. Hydrazoic acid did react with 3-(diacetylamino)-2-chloropyridine to give only small yields of the pyridotetrazole. The major reaction was one of hydrolysis. The reactivity of these compounds was explained by the electronic effects of the substituents on the carbon atom containing the halo atom.

The reaction of 2-chloro-3-pyridinol with hydrazoic acid in the presence of excess acid gave 8-hydroxypyridotetrazole. A second, unidentified product was, however, formed in the major reaction. The formation of 6-hydroxypyridotetrazole resulted unexpectedly from the reaction of 5-amino-2-chloropyridine with hydrazoic acid. No explanation of this behavior is attempted.

There was observed no reaction of 2-amino-6-bromopyridine or 4-amino-2-bromopyridine with hydrazoic acid. This was attributed to the resonance of the amino groups with the hetrocyclic nitrogen atom. This explanation was supported by other examples from the literature.

The recovery of starting material from the reaction of 2-bromo-4-nitropyridine with hydrazoic acid was observed. This is perhaps associated with the low basicity of the pyridine derivative. Such an explanation would require an interaction involving the heterocyclic nitrogen atom, which facilitated the reaction.

Infrared and ultraviolet spectra of the amino and hydroxypyridotetrazoles indicated the absence of the azide form both in the solid state and in solution. The spectra are compared with those of other tetrazole derivatives. The spectrum of 8-hydroxypyridotetrazole indicates chelation. This chelation is presumed to occur with the electron rich tetrazole ring. Such effects are not noted in 6-hydroxypyridotetrazole. The ultraviolet spectrum of the

latter compound does, however, seem to indicate the presence of an equilibrium which does not involve an azide structure. Microfilm $2.00; Xerox $3.80. 67 pages.

EXPLORATIONS OF NEW ROUTES TO AZETIDINE.

(L. C. Card No. Mic 59-4944)

Robert Stephen Klonowski, Ph.D.
University of Michigan, 1959

The purpose of this investigation was to study new methods by which azetidine and its derivatives could be prepared. The reactions studied were: 1) reduction of 2-azetidinones with metal hydrides, 2) cyclization of 3-sulfonamidoalkyl sulfonate esters, 3) cyclization of 3-aminoalkyl sulfonate hydrochlorides, and 4) reduction of sulfonazetidides.

The reduction of 1,4-diphenyl-3,3-dimethyl-2-azetidinone with various metal hydrides resulted in ring-opening concurrent with the reduction of the carbonyl group to give β,β-dimethyl-γ-anilinohydrocinnamyl alcohol. Catalytic reduction (Ni (R) catalyst) gave α,α-dimethyl-β,N-dicyclohexylpropionamide.

3-(p-Toluenesulfonamido)propyl p-toluenesulfonate and 4-p-toluenesulfonamido-2-butyl p-toluenesulfonate were prepared from the corresponding aminoalcohol by treatment with p-toluenesulfonyl chloride. Treatment of the disulfonyl derivatives with sodium ethoxide resulted in ring closure to p-toluenesulfonazetidide and 2-methyl-p-toluenesulfonazetidide. 3-Aminopropanol on treatment with methanesulfonyl chloride gave N-(3-chloropropyl)-methanesulfonamide which was cyclized to methanesulfonazetidide with sodium ethoxide. An intermolecular reaction began to occur in the cyclization of 3-(p-toluenesulfonamido)propyl p-toluenesulfonate when the concentration of the latter was 0.097M. High dilution addition of 4-p-toluenesulfonamido-2-butyl p-toluenesulfonate to a refluxing solution of sodium ethoxide in absolute ethanol increased the yield of the azetidide with no indication of an intermolecular reaction.

Condensation of 3-aminopropanol with benzaldehyde gave N-(3-hydroxypropyl)benzaldimine and not 2-phenyl-1, 3-tetrahydrooxazine as reported in the literature. The structure of the Schiff base was confirmed by its infrared and ultraviolet spectra. Ring closure results on treatment with benzoyl chloride or p-toluenesulfonyl chloride.

No 3-aminopropyl p-toluenesulfonate hydrochloride could be isolated from the reaction of 3-aminopropanol hydrochloride with p-toluenesulfonyl chloride. However, 3-benzylaminopropyl p-toluenesulfonate hydrochloride was prepared from 3-benzylaminopropanol hydrochloride. The reaction of 3-benzylaminopropyl p-toluenesulfonate hydrochloride with base gave 1-benzylazetidine.

1-Benzylazetidine was also prepared by the action of base on the hydrogen sulfate ester of 1-benzylaminopropanol. Azetidine was prepared by reduction of methanesulfonazetidide with sodium in amyl alcohol and by catalytic debenzylation of 1-benzylazetidine. 2-Methylazetidine was prepared from 2-methyl-p-toluenesulfonazetidide by reduction with sodium in amyl alcohol.

Microfilm $2.00; Xerox $5.00. 98 pages.

THE STEREOCHEMISTRY OF THE OXIDATION OF 2-SEC-BUTYLBENZOIC ACID TO 3-ETHYL-3-METHYLPHTHALIDE BY VARIOUS OXIDIZING AGENTS.

(L. C. Card No. Mic 59-3586)

Edward C. Kramer, Jr., Ph.D.
Rutgers University, 1959

A stereochemical study of the oxidation of optically active 2-sec-butylbenzoic acid by various oxidizing agents was made.

Methods for the preparation of 2-sec-butylbenzoic acid from phthalic anhydride and from 2-amino-chlorobenzene are given. The resolution of 2-sec-butylbenzoic acid with strychnine is described. A sample of the strychnine salt, which was crystallized to constant physical properties, was decomposed to give 2-sec-butylbenzoic acid ($[\alpha]_D^{26.0}$ $+22.9^0$).

A theoretical discussion of the reaction species arising from the one- and two-electron oxidations of 2-sec-butylbenzoic acid, which lead to 3-ethyl-3-methylphthalide, is presented. The modes of racemization of these intermediates are discussed.

The experimental data show that, with one-electron oxidizing agents, optically active 2-sec-butylbenzoic acid is converted to racemic 3-ethyl-3-methylphthalide. Conversely, with two-electron oxidizing agents, optically active 2-sec-butylbenzoic acid is converted to optically active 3-ethyl-3-methylphthalide with inversion of configuration.

The experimental data show that oxidation by dilute alkaline potassium permanganate and chromic acid in acetic acid solution gave optically active 3-ethyl-3-methylphthalide. Potassium manganate in strongly alkaline solution has been found to oxidize optically active 2-sec-butylbenzoic acid to completely racemic 3-ethyl-3-methylphthalide. This potassium manganate oxidation is believed to have occurred via a one-electron oxidation process and a mechanism for this process has been suggested.

Calculations were made from the stereochemical data compiled from the dilute alkaline potassium permanganate and chromic acid oxidations of 2-sec-butylbenzoic acid to 3-ethyl-3-methylphthalide, which indicate that 33% and 15% racemization occurred in these oxidations.

The Hunsdiecker reaction with optically active silver 2-sec-butylbenzoate gave a good yield of racemic 3-ethyl-3-methylphthalide. These results have been interpreted as being due to a free radical chain-reaction taking place in the oxidation process. Similarly potassium persulfate and N-bromosuccinimide gave racemic 3-ethyl-3-methylphthalide from optically active 2-sec-butylbenzoic acid.

2-Diazoacetyl-sec-butylbenzene was decomposed in the presence of copper oxide to give an impure racemic ketone believed to be 3-ethyl-3-methylindanone-1. The indanone compound was further characterized by preparation of its 2,4-dinitrophenylhydrazone. A mechanism involving a diradical has been presented to explain these results.

Microfilm $2.00; Xerox $4.20. 80 pages.

STEREOSELECTIVE BASE-CATALYZED ADDITIONS OF THIOLS TO ACETYLENES.

(L. C. Card No. Mic 59-4160)

Robert Bruce Kruse, Ph.D.
Purdue University, 1959

Major Professor: William E. Truce

Part I. The Stereochemistry of the Base-Catalyzed Addition of p-Toluenethiol to Propiolic Acid.

The exception to the Rule of trans-Nucleophilic Addition reported by Truce and Heine[1] for the nucleophilic addition of p-toluenethiol to sodium propiolate was discounted by Montanari and Negrini,[2] whose configurational assignments to the geometrical isomeric β-p-tolylmercaptoacrylic acids were in conflict with those of Truce and Heine, who assigned the trans configuration to the major product of the addition of p-toluenethiol to sodium propiolate. Additional evidence for this configurational assignment has been obtained.

A comparison of the ease of cyclization of the trans compound with cis-p-tolylmercaptoacrylic acid (obtained by addition of p-toluenethiol to ethyl propiolate and subsequent hydrolysis) show a marked difference in the amount of 6-methylthiochromone formed when the acids are treated with thionyl chloride and aluminum chloride in carbon disulfide for limited reaction periods. Comparison of the infra-red spectra of the sulfone derivatives of these compounds also supports the indicated configurational assignments. Evidence of internal hydrogen bonding is present in the spectrum of the cis isomer in the form of a lowering of the carbonyl stretching frequency and the appearance of OH stretching vibrations similar to the dimeric forms of acids.[3]

Excellent physical evidence for the assigned configurations has been obtained by measurements of the dipole moments of the isomeric sulfones in dioxane solution. The cis isomer exhibits a dipole moment of 5.10 D and the trans isomer 4.39 D in dioxane. The dipole moment of the molecule would be expected to be greater when the two electron-withdrawing substituents are located on the same side of the molecule.

Part II. The Stereochemistry of the Base-Catalyzed Addition of p-Toluenethiol to Disodium and Diethyl Acetylenedicarboxylate.

The nucleophilic addition of p-toluenethiol to disodium and diethyl acetylenedicarboxylate have been shown to follow the Rule of trans-Nucleophilic Addition. The product of the addition of thiol to diethyl acetylenedicarboxylate, upon hydrolysis, gave a compound identical to that which resulted from the addition of thiol to disodium acetylenedicarboxylate. This was shown to be p-tolylmercaptofumaric acid by slow thermal isomerization to p-tolylmercaptomaleic acid, which formed a sublimable anhydride. Upon treatment with refluxing acetyl chloride, the maleic acid derivative gave an excellent yield of anhydride, whereas the isomeric acid could be recovered unchanged.

The trans mode of addition of p-toluenethiol to diethyl acetylenedicarboxylate is probably due to the usual coulombic effects governing trans-nucleophilic addition,[1,4] whereas the stereochemistry of the addition of thiol to disodium acetylenedicarboxylate is presumably due to coulombic repulsion between the carboxylate groups.

Part III. The Stereochemistry of the Nucleophilic Addition of Mesitylenethiol to Mesitylacetylene.

In an attempt to determine whether the steric requirements of a bulky nucleophilic agent, when added to an acetylene bearing a bulky substituent group, could force cis-nucleophilic addition (in a manner similar to coulombic repulsion) mesitylenethiol and mesitylacetylene were prepared, and the nucleophilic addition was carried out. The infra-red spectrum of the resulting product indicated that it had a cis configuration. More rigorous evidence for configurational assignment was obtained by an independent synthesis of trans-mesityl-(mesitylsulfonyl)-ethene, which was then compared with the sulfone derivative of the product of the addition of mesitylenethiol to mesitylacetylene. The infra-red spectra of these compounds were fairly typical of a cis-trans pair. Furthermore, the compound to which the cis configuration was assigned could be isomerized to the trans compound.

Apparently, since the usual trans-nucleophilic addition was observed, the driving force for this mode of addition is sufficiently great to overcome the steric requirements of a mesityl and a mesitylthio group in a cis relationship to each other.

Part IV. Miscellaneous Investigations: The Addition of Pentachlorobenzenethiol to Mesitylacetylene; The Addition of p-Toluenethiol to Phenylchloroacetylene.

Another bulky nucleophile, pentachlorobenzenethiol, was added to mesitylacetylene. Again the mode of addition was apparently trans, since the infra-red system of the product indicated the cis configuration.

Addition of p-toluenethiol to phenylchloroacetylene appears to have resulted in formation of an unsaturated compound containing two p-tolylmercapto groups.

Microfilm $2.45; Xerox $8.40. 185 pages.

A PHYTOCHEMICAL INVESTIGATION OF OF DELPHINIUM OCCIDENTALE S. WATSON AND A STRUCTURAL INVESTIGATION OF THE ALKALOID DELTALINE.

(L. C. Card No. Mic 59-4023)

Dana Walker Mayo, Ph.D.
Indiana University, 1959

An efficient quantitative method for the separation of Delphinium alkaloids has been developed by employing adsorption chromatography on "Woelm" neutral alumina. Deltaline, $C_{27}H_{41}NO_8$, has been confirmed as the major alkaloid present in the tall larkspur, Delphinium occidentale S. Watson (69, 102). Furthermore, in addition to the known bases delpheline, delsoline, and delcosine, the new alkaloids deloccine - $C_{24}H_{37}NO_5$, delphoccine - $C_{26}H_{39}NO_8$, delphoccamine - $C_{24}H_{37}NO_7$, ocacine - $C_{20}H_{30}N_2O_3$, occidelphine - $C_{24}H_{35}NO_7$, deltamine - $C_{25}H_{39}NO_7$, de-ethyloxodeltaline - $C_{25}H_{35}NO_9$, and occidentine (no empirical formula yet established) have been isolated from D. occidentale. The important Aconitum-Delphinium alkaloid, lycoctonine, however, does not occur in D. occidentale in measurable quantities. Together, these crystalline compounds represent the largest number of alkaloids ever to be obtained from a single Delphinium species.

The chemistry of the principal alkaloid of D. occidentale, deltaline, has been investigated. Deltaline has been demonstrated to possess a tertiary crypto-hydroxyl group not recognized in previous studies (90, 102). The functionality of deltaline has been revised and a new expanded formula proposed:

$$C_{17}H_{18}(>NCH_2CH_3)(-OCH_2O-)(\equiv C-CH_3)(-OCH_3)_3-(-OCOCH_3)(-OH)$$

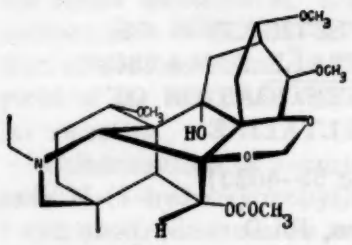
Replacement of the hydroxyl group of deltaline with hydrogen and conversion of the acetoxyl group to hydroxyl produces delpheline. Treatment of deltaline with highly purified thionyl chloride at room temperature gives chlorodesoxydeltaline. The reaction of chlorodesoxydeltaline with lithium aluminum hydride in refluxing ethyl either yields delpheline. This transformation proves that deltaline and delpheline have the same carbon skeleton.

It has been shown (89) that on methylation and acid hydrolysis delpheline can be converted to desoxylycoctonine. This result would seem to imply that deltaline, delpheline, and lycoctonine all contain the same basic skeleton (144).

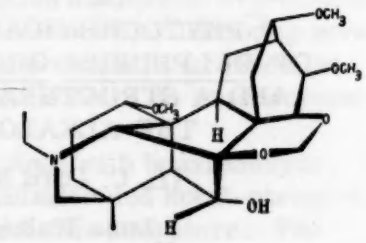
The diol, deltamine, spontaneously undergoes dehydrohalogenation during treatment with thionyl chloride to yield the olefin, desoxydehydrodeltamine (90). This reaction involves elimination at the tertiary position originally bearing the crypto-hydroxyl group.

The lycoctonine structure, as elucidated by the X-ray crystallographic study of Przybylska and Marion (116), cannot accommodate the tertiary hydroxyl group at a position which is sterically compatible with the formation of desoxydehydrodeltamine. Deltaline and delpheline, therefore, possess a skeleton different from lycoctonine, but one in which rearrangement can occur to produce the latter skeleton during the cleavage of the methylenedioxy ring system.

From the above considerations and other data obtained in the present study, it is now possible to set forth, for the first time, a total structure for deltaline (I) and in addition to suggest a revised formulation for delpheline (II).



I.
Deltaline



II.
Delpheline

The skeleton of deltaline (I) and delpheline (II) uniquely contains a tertiary position which is consonant with the known reactions of the crypto-hydroxyl group. Furthermore, the proposed carbon skeleton can undergo a Wagner-Meerwein-type rearrangement, during the acid hydrolysis of the acetal linkage, to produce the lycoctonine skeleton in demethylenedeltamine and demethylenedelpheline.

Microfilm $2.80; Xerox $9.80. 216 pages.

A STUDY OF RING CLOSURE ISOMERIZATION OF THE AZIDO AZOMETHINE GROUP.

(L. C. Card No. Mic 59-4198)

Eugene James Miller, Jr., Ph.D.
Tulane University, 1959

Chairman: J. H. Boyer

The observation, made previously, that cyclization of the azidoazomethine group does not occur when contained in a five-membered heterocyclic azide was investigated. Cyclization of the azidoazomethine group with the formation of 5, 6-dihydro-7-imidazo [1, 2] tetrazole and trimethylenetetrazole was confirmed by the lack of azide absorption bands in the infrared and ultraviolet absorption spectra. The strong azide absorption bands in the infrared absorption spectra of the solution and solid state of 3-azido-1, 1-dioxobenzothiazole-1, 2 indicated that no cyclization of the azidoazomethine group had occurred in this case. Cyclization did occur, however, in 2-azidobenzothiazole-1, 3 with the formation of 1, 5-tetrazolobenzothiazole-1, 3. The infrared absorption spectrum of the solid state showed no azide bands. However, the presence of azide bands in the infrared spectrum of a chloroform solution indicated an unprecedented opening of a tetrazole ring to the isomeric azide under very mild conditions. Chromatographic analysis showed the two isomeric forms to exist in equilibrium in solution. Similar results were obtained upon spectral and chromatographic analysis of 6-nitropyridotetrazole constituting another example of a tetrazole ring opening.

Trimethylenetetrazole was prepared by the replacement of the thioether group of 2-methylmercaptopyrrolidine using hydrazoic acid which corroborated an earlier preparation from ω-azidobutyronitrile.

Tentative assignments of tetrazole absorption bands were made for 5,6-dihydro-7-imidazo [1,2] tetrazole, trimethylenetetrazole, 1,5-tetrazolobenzothiazole-1,3,6-nitropyridotetrazole and pyridotetrazole. The tetrazole ring was found to exhibit absorption in the regions of 9.0-10.0μ and 13.0-13.7μ which is in agreement with earlier work. Microfilm $2.00; Xerox $3.80. 67 pages.

FREE RADICAL REARRANGEMENTS AND ELIMINATIONS.

(L. C. Card No. Mic 59-4540)

Theodore Charles Miller, Ph.D.
University of Illinois, 1959

Thermal decomposition of di-(3,3,3-triphenylpropionyl)-diimide at 175° gave as the only identified product 1,1,1,6, 6,6-hexaphenyl-3,4-hexandione in 45% yield. Decomposition of the diimide in refluxing toluene gave the diketone in 25% yield. When the thermal decomposition of the diimide was carried out in refluxing xylene at 137° and in decalin at 160° and at 180°, triphenylethylene and 1,1,2-triphenylethane, resulting from the decarbonylation of the 3,3,3-triphenylpropionyl free radical and 1,2-phenyl group migration in the 1,1,2-triphenylethyl free radical thus formed, as well as diketone, were formed. Diketone in 29% yield,

triphenylethylene in 8% yield, and 1,1,2-triphenylethane in a maximum yield of 17% were formed in the decomposition in xylene. Diketone in 31% yield, triphenylethylene in 13% yield, and 1,1,2-triphenylethane in 10% yield were formed in the decomposition in decalin at 160°. Diketone in 43% yield, triphenylethylene in 14% yield, and 1,1,2-triphenylethane in 11% yield were formed in the decomposition in decalin at 180°. Small amounts of N,N'-di-(3,3,3-triphenylpropionyl)-hydrazine (2-6% yields) were obtained from the decompositions in toluene and decalin.

Solid 2,2,2-triphenylethylhydrazine decomposed in air at room temperature with loss of nitrogen and formation of benzophenone. Bubbling air through a refluxing benzene solution of the hydrazine gave benzophenone in 28% yield.

Thermal decomposition of methylazo-2,2,2-triphenylethane at 206° under incomplete exclusion of air gave triphenylmethane in 23% yield and benzophenone in 6-10% yield.

The reaction of ethyl 3,3,3-triphenylpropionate and sodium in xylene at 119° gave triphenylmethane in 42% yield.

Microfilm $2.00; Xerox $6.00. 121 pages.

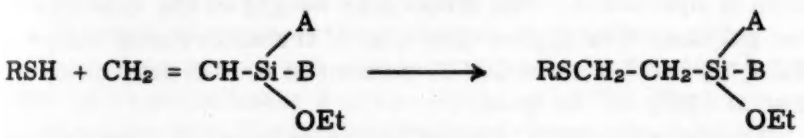
PART I: ADDITION OF MERCAPTANS TO VINYL SILANES.
PART II: ASPECTS OF STEREOSPECIFIC POLYMERIZATION.

(L. C. Card No. Mic 59-3631)

James E. Mulvaney, Ph.D.
Polytechnic Institute of Brooklyn, 1959

Adviser: Charles G. Overberger

Part I. - In an effort to obtain polar organosilane monomers a number of mercaptans were added to vinylsilanes containing functional groups capable of undergoing condensation polymerization or copolymerization.

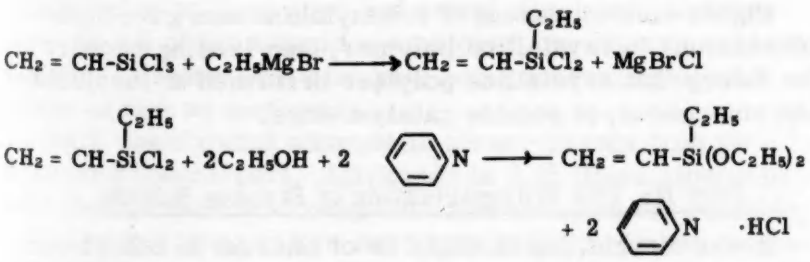


R = ϕ or ϕCH_2

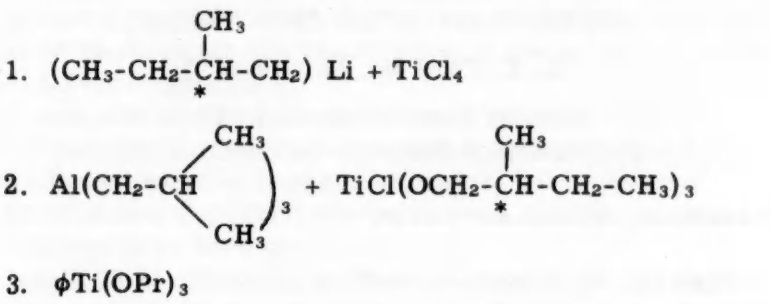
A and B = CH_3- or -OEt

It was not possible to isolate products of the attempted oxidations of the silane sulfides to sulfones.

During the course of this work new vinylethoxysilane monomers were prepared according to the following equations:

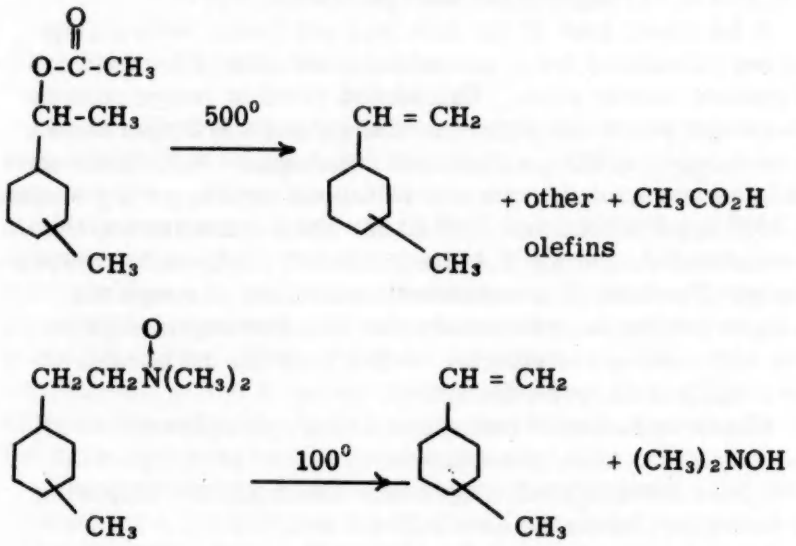


Part II. - A number of optically active Ziegler-Natta catalyst systems were studied in an investigation of asymmetric induction in polymer synthesis. Although attempts have been made to prepare asymmetric polymers by means of optically active free-radical initiators, this approach has been shown to be unfeasible on theoretical grounds. However, in Ziegler-Natta polymerizations the polymer chain grows at the catalyst site and would be expected to come continually under the steric influence of the catalyst. The catalyst systems listed below were investigated under a variety of reaction conditions.



None of the catalyst systems investigated produced stereospecific polymers.

A number of crystalline α-olefin polymers have now been prepared. In order to study the effect of ring structure in the side chain the pure cis or trans isomers of 2-methyl, 3-methyl- and 4-methylvinylcyclohexane have been prepared via an acetate cracking procedure or an amine oxide pyrolysis procedure. The essential step in each synthesis is indicated below.



The polymerization of the monomers was carried out with aluminum triisobutyl and titanium tetrachloride in heptane. 3-Methyl- and 4-methylvinylcyclohexane gave linear crystalline, high molecular weight polymers. Under the conditions employed 2-methylvinylcyclohexane gave an insoluble polymer.

In an effort to study the mechanism of termination in Ziegler-Natta catalyst systems, vinylcyclohexane-α-d was prepared. Comparison of the intrinsic viscosities of polymers of vinylcyclohexane and vinylcyclohexane-α-d, prepared under identical conditions in a high vacuum apparatus using aluminum triethyl and titanium tetrachloride in heptane, was made. The intrinsic viscosities were the same within the limit of experimental error. Although the breaking of a carbon-hydrogen bond must occur in at least one

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

of the possible transfer steps, it was undetectable isotopically. It was also found that the logarithm of the polymer intrinsic viscosity decreases linearly with the concentration of titanium tetrachloride.

Microfilm $2.00; Xerox $4.60. 86 pages.

KINETICS OF THE BASIC HYDROLYSIS OF RING-HALOGENATED ETHYL PHENOXYACETATES. FREE RADICAL ATTACK ON ACIDS AND AMIDES.

(L. C. Card No. Mic 59-4395)

Herbert Charles Newsom, Ph.D.
University of Southern California, 1959

Chairman: Professor Brown

Rates of hydrolysis by sodium hydroxide in 87.5 per cent aqueous ethanol were measured for ethyl phenoxyacetate and the 2-substituted, the 4-substituted, and the 2,4-disubstituted esters, with fluorine, chlorine, bromine, and iodine as substituents. The kinetics were studied at 0° C. and 30° C., and enthalpies and entropies of activation were calculated. All of the halogenated esters reacted faster than the unsubstituted compound, the activation usually appearing both as lower $\Delta H^{\ddagger}$ and less negative $\Delta S^{\ddagger}$ values. The activation enthalpy varied from 11.33 to 13.18 Kcal./mole, and the entropy of activation varied from -15.60 to -22.16 e.u. throughout the series.

A Hammett plot of the data was not linear with sigma values calculated from ionization constants of benzoic or of phenoxyacetic acids. Calculated rates at temperatures above and below the experimental values were also shown to be inapplicable to a Hammett treatment. Activation enthalpies were linear with activation entropies, giving slopes of 283° K., 276° K., and 276° K. for the 2-substituted, the 4-substituted, and the 2,4-disubstituted compounds, respectively. The lack of a consistent rate order through the halogen series is presumably due to superimposed inductive and tautomeric effects. Other possible influences of the substituents were discussed.

The orientation of radical attack on phenylacetic acid, phenoxyacetic acid, phenylacetamide, and phenoxyacetamide was investigated, employing thermally decomposing di-tert-butyl peroxide as a radical source.

Methyl radicals were found to abstract the alpha hydrogen from phenylacetic acid to form methane. Combination of the resultant radicals produced α,α'-diphenylsuccinic acid, the sterically favored meso configuration predominating over the dl form to the extent of 9:1. No carbon dioxide was given off in this reaction, nor was any methyl phenylacetate isolated.

Phenoxyacetic acid underwent attack by methyl radicals at the carboxyl hydrogen, followed by decarboxylation of the formed radicals. A small amount of phenol was also isolated from this reaction, giving an indication of some radical displacement processes. Carboxyl hydrogen abstraction in this case, as evidenced by carbon dioxide evolution, may be compared with the results of Brown and Jamison, who found the same product from the reaction of phenoxyacetic acid and hydroxyl radicals, thus pointing to the generality of the deactivating effect of the phenoxy group to free radical attack on adjacent C-H bonds.

Methyl radicals with phenylacetamide produced α,α'-diphenylsuccinamide, the expected product from an initial attack at the alpha hydrogen of the substrate. In addition, some basic gas was evolved which was tentatively identified as ammonia. A radical displacement process may have been involved here, also. Phenoxyacetamide reacted with decomposing di-tert-butyl peroxide to form a basic gas and some dark products, but none of these materials were identified.

Microfilm $3.00; Xerox $10.20. 230 pages.

THE POLYMERIZATION OF PHENYL GLYCIDYL ETHER AND OF STYRENE SULFIDE.

(L. C. Card No. Mic 59-4649)

Allen Noshay, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Charles C. Price

Part I: The Polymerization of Phenyl Glycidyl Ether

The discovery of the capability of certain catalysts to convert propylene oxide to both isotactic and atactic polymer has led us to investigate the effect of such catalysts on the polymerization of monomers related to propylene oxide. The work reported here is concerned with the polymerization of phenyl glycidyl ether (phenoxypropylene oxide).

Phenyl glycidyl ether has been polymerized by aluminum isopropoxide - zinc chloride and by triethylaluminum to both crystalline and amorphous polymer in conversions as high as 91%. The crystalline fractions, which accounted for about half of the polymer formed, were high melting (206°), white powders, insoluble at room temperature but soluble in several hot solvents, eg. cyclohexanone, o-dichlorobenzene. The amorphous fractions varied from viscous oils to white, rubbery solids, soluble in benzene at room temperature. The molecular weight of the crystalline polymer was higher than that of the amorphous material ($[\eta]$, 0.467 versus 0.170, measured in o-dichlorobenzene at 121°).

Triethylaluminum is an effective catalyst at room temperature, while aluminum isopropoxide - zinc chloride requires a reaction temperature of 80° to catalyze polymerization at a reasonable rate.

Higher conversions to polymer were obtained with aluminum isopropoxide - zinc chloride than with triethylaluminum, but the crystalline fractions obtained with the latter catalyst had higher melting points than those obtained with the former.

Water enhanced the catalytic activity of triethylaluminum when the catalyst to water mole ratio was 2:1.

Higher concentrations of triethylaluminum gave higher conversions to crystalline polymer, thus lending support to the theory that crystalline polymer is formed at insoluble and amorphous, at soluble catalyst sites.

Part II: The Polymerization of Styrene Sulfide

It was thought that it might be of interest to extend our studies of epoxide polymerization to the episulfide system to see if these compounds could be polymerized to high

molecular weight and/or crystalline material, as had been done with their oxygen analogs. The model compound chosen for this study was styrene sulfide.

Styrene sulfide formed the cyclic dimer, 2,5-diphenyl-p-dithiane when mixed with dimethyl sulfate at room temperature.

It polymerized at room temperature in the absence of a catalyst to a white, solid material in about 50% conversion, which was soluble in benzene at room temperature. The polymer softened at about 50° to a rubbery mass which, in turn, became a tacky liquid at about 120°. The polymer, which was shown by X-ray analysis to be amorphous, formed fairly tough, rubbery films.

Several catalysts were successful in polymerizing styrene sulfide to material of a higher molecular weight than that obtained without a catalyst. The highest molecular weight ($[\eta] = 2.05$) was obtained from the reaction catalyzed by chloro cadmium butyl mercaptide at -20°. The molecular weights of the polymers obtained were inversely proportional to the reaction temperatures.

Unfortunately, polystyrene sulfide is not a very stable polymer. Ultraviolet light degraded it considerably at room temperature. Thermal degradation was appreciable at 139° and extensive at 197°, both in the presence and absence of air. One of the products of the degradation, at 197°, of the polymer obtained from the reaction catalyzed by chloro cadmium butyl mercaptide has been identified as 2,5-diphenyl-p-dithiane.

Oxidation of polystyrene sulfide with hydrogen peroxide gave a material which appeared to be polystyrene sulfone.

Microfilm $2.00; Xerox $5.20. 105 pages.

THE RELATIVE NUCLEOPHILICITIES OF SEVERAL SODIUM ALKOXIDES.

(L. C. Card No. Mic 59-4297)

Robert Joseph Petfield, Ph.D.
Lehigh University, 1959

The rate of nucleophilic substitution reactions of a variety of saturated and unsaturated sodium alkoxides have been determined using 2-bromopyridine as the electrophilic substrate. To facilitate comparisons, the rate constants have been calculated at 100°C. The rate constant obtained using sodium allyloxide has been arbitrarily assigned the value of 1.0.

For the homologous series of alkoxides from methoxide to pentoxide, the relative rates show a trend in increasing reactivity. Thus pentoxide in pentanol is about three times faster in rate than methoxide in methanol. In this same series, the Arrhenius activation energy is essentially constant at 26.5± .1 K cal. The rate increase is manifested by a more positive entropy of activation. This rate increase is attributed to the nature and extent of solvent participation. Of all of the alkoxides employed, cyclohexylmethoxide affords the fastest relative rate being approximately 3.5 times as fast as methoxide.

Each unsaturated alkoxide is slower in rate than its saturated counterpart. Allyloxide is 3.25 times slower in rate than propoxide. Using the value obtained for butoxide, 3.88, the following values were obtained for related unsaturated alkoxides; namely, 3-buten-1-oxide gave a value of 2.1, crotyloxide yielded 2.4, and 2-butyn-1-oxide afforded 0.48. Similarly, 4-penten-1-oxide yielded 3.33 whereas pentoxide gave a value of 4.56. The value obtained for cyclohexylmethoxide was 5.17 whereas benzyloxide yielded 1.23. The activation energies are also higher for the reactions using the unsaturated alkoxides, being 27.4± .2 K cals. with the exceptions of benzyloxide and 2-butyn-1-oxide at 28.5± .15 K cals. and 4-penten-1-oxide at 26.8± .15 K cals.

The theory of hydride-ion hyperconjugation does not explain the trends observed in the above groups of alkoxide ion reactivities. A factor which might be responsible for the generally slower reactivity of the unsaturated alkoxides could be base-catalyzed deactivation of the polarized molecule of 2-bromopyridine.

It was also shown that aluminum allyloxide failed to participate in the carbinol-carbonyl equilibrium reaction with a known hydride transfer acceptor, benzophenone.

Several new 2-pyridyl ethers as well as their picrate derivatives have been prepared.

Microfilm $2.00; Xerox $4.00. 75 pages.

SOME MANIFESTATIONS OF STERIC INTERACTIONS ON THE BENZENE RING -- THE BUTTRESSING EFFECT.

(L. C. Card No. Mic 59-4769)

Leon Rand, Ph.D.
The University of Texas, 1958

Supervisor: Pete D. Gardner

In an effort to determine the magnitude of the buttressing effect (the exaggerated steric effect of an ortho-substituent due to the presence of a meta-substituent), two methods were employed. The first method involved the determination of electronic spectra of various substituted acetophenones so that increased aplanarity of the carbonyl group with increased steric hindrance by an ortho-group might be shown. This was done by comparing the extinction coefficients of the K-bands of ultra-violet spectra, the lowering of these values indicating greater lack of planarity of the carbonyl group with respect to the phenyl group.

The buttressing effect was shown to exist in the 2,3,4-trimethoxy-, 2-methoxy-3,4-diethoxy-, and 2,3,4-triethoxyacetophenone series. It was found, however, that whereas a methyl group meta- to a methoxy group results in a greater steric interaction with the carbonyl group, a bulkier meta-isopropyl group does not exert a buttressing effect, but instead probably pushes the methoxy group out of the plane of the ring. The same effect was noted for 3-methyl-4-methoxy- and 3-isopropyl-4-methoxyacetophenone.

The second method was a determination of the enolic content of each of the substituted acetophenones with methylmagnesium iodide and with lithium aluminum hydride. Methylmagnesium iodide, having a greater steric requirement than lithium aluminum hydride, reacts more rapidly with the enol form than with the ketonic form, thus allowing a re-equilibration of these forms and therefore a higher apparent enol content than is obtained with lithium aluminum hydride which reacts almost simultaneously with both forms. The difference between values of the percent enol

as determined by the two reagents is, therefore, proportional to the degree of hindrance at the carbonyl group. Steric differences thus measured compare favorably with those reflected in spectral data for 1-indanone, 1-tetradone, and benzosuberone and also parallel interpretations of spectral data for 3-isopropyl-2-methoxy-5-methylacetophenone and 5-isopropyl-2-methoxy-3-methylacetophenone. They do not correspond with spectral data in the 2,3,4-trialkoxyacetophenone series.

Several new compounds are reported, namely, 3,4,5-triethoxyacetophenone, 2-methoxy-3,4-diethoxyacetophenone, 3-isopropyl-2-methoxy-5-methylacetophenone, 5-isopropyl-2-methoxy-3-methylacetophenone, 2-tert-butyl-4-methylanisole, 2,6-ditert-butyl-4-methylanisole, 2-(triethylmethyl)-4-methylanisole, 2-methyl-4-tert-butylphenyl benzoate, 3-isopropyl-4-methoxyacetophenone, and 3,5-diisopropyl-4-methoxyacetophenone.

Microfilm $2.00; Xerox $4.20. 79 pages.

STEROIDAL NITROGEN MUSTARDS.

(L. C. Card No. Mic 59-4652)

Ganti Venkat Rao, Ph.D.
University of Pennsylvania, 1959

Supervisor: Charles C. Price

The syntheses of nitrogen mustards of the general formula $RN(CH_2CH_2Cl)_2$, where R is related to a steroidal unit have been described in order to investigate their possible use for carcinolytic activity. Two principal reactions have been employed for this purpose.

A. $RNH_2 + CH_2\text{—}CH_2 \longrightarrow RN(CH_2CH_2OH)_2$ (O bridge)

B. $RX + HN(CH_2CH_2OH)_2 \longrightarrow RN(CH_2CH_2OH)_2$

The chlorination of the glycols, using thionyl chloride in anhydrous chloroform, gave the nitrogen mustards, which were always isolated as the hydrochlorides.

For the syntheses of steroidal primary amines, RNH_2 the methods followed were either the reduction of oximes with sodium and butanol or the reduction of acid amides with lithium aluminum hydride.

For the synthesis of steroidal alkylating agents, RX, the main consideration was the location of X. For the 3-position, the easiest and quickest method was the tosylation of the commercially-available 3-hydroxy steroids. When the location of X was on C-24, the method consisted in converting the C-24 alcohol, obtained by the reduction of the appropriate cholanic acid, to the chloride.

Amines in which R is a secondary alkyl group, 3β-aminocholestane, 3ξ-amino-4-androstene-17β-ol, and 20ξ-amino-3β-methoxy-5-pregnene, when allowed to react with ethylene oxide in methanol solution, gave the corresponding bis(β-hydroxyethyl)amino derivatives. Chlorination of the glycols in chloroform solution with thionyl chloride gave the corresponding bis(β-chloroethyl)amino derivatives.

The reaction of ethylene oxide in methanol solution with amines in which R is a primary alkyl group, e.g. 24-aminocholane, and with 3β-methoxy-24-aminocholane, resulted in the quaternary ammonium alcoholate, i.e. $R\overset{+}{N}(CH_2CH_2OH)_3\ \bar{O}CH_3$, (R = steroidal counterpart).

The replacement of chlorine in cholanyl chloride and 3β-methoxy-24-cholanyl chloride by diethanolamine on refluxing in diglyme ($CH_3OCH_2CH_2OCH_2CH_2OCH_3$) for eight hours gave 24-bis(β-hydroxyethyl)aminocholane and 3β-methoxy-24-bis(β-hydroxyethyl)aminocholane. Both the diols, by reaction with thionyl chloride in chloroform solution, gave the corresponding nitrogen mustards. The replacement of the tosyl group in 12-hydroxy-24-cholanyl tosylate in diglyme solution by diethanolamine resulted in 12-hydroxy-24-bis(β-hydroxyethyl)aminocholane. However, the chlorination of this glycol was not successful, perhaps due to the free 12-hydroxyl group.

The replacement of the chlorine in 20ξ-chloro-3β-methoxy-5-pregnene by diethanolamine in diglyme solution was not successful. The displacement of the tosyl group in pregnenolone 3-tosylate in diglyme solution resulted in 3ξ-bis(β-hydroxyethyl)amino-5-pregnene-20-one in rather low yield. Chlorination with thionyl chloride resulted in the bis(β-chloroethyl)amino derivative.

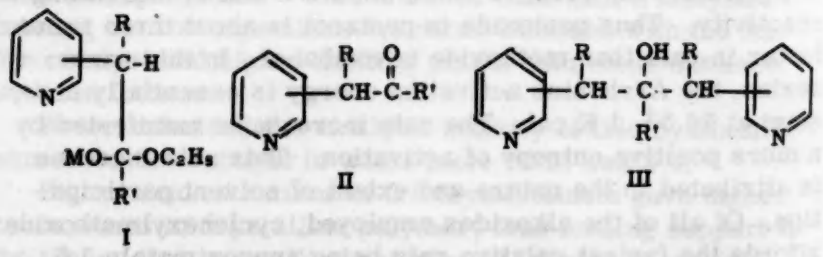
17ξ-Amino-1,3,5(10)-estratriene-3-ol, when allowed to react with ethylene oxide in methanol, yielded mainly a product which was insoluble in the usual organic solvents and was characterized as the N-monohydroxyethlamino compound, i.e. $RNHCH_2CH_2OH$, (R= 1,3,5(10)-estratriene-3-ol residue). Microfilm $2.00; Xerox $5.20. 102 pages.

THE ALKYLATION AND ACYLATION OF CERTAIN TAR BASE DERIVATIVES.

(L. C. Card No. Mic 59-4464)

Stuart Raynolds, Ph.D.
University of Pittsburgh, 1959

The large body of new data concerning the acylation of tar base derivatives which was obtained during the present study as well as the information on this subject which was available prior to the present study have been rationalized by means of a new mechanism. Thus, it is suggested that the interaction of an alkali metal derivative of an alkyl-substituted pyridine (i.e., 2-, 3- and 4-$C_5H_4NCH_2R$, where R is a hydrogen atom or a phenyl radical) with an ester (i.e., $R'CO_2C_2H_5$, where R' is an alkyl or phenyl radical) gives an adduct, I, which is assumed to be the intermediate in the production of the final products, ketone, II, and carbinol, III.



The following factors were found to determine the course of the reactions in terms of the yields of ketone, II, and carbinol, III:

(1) Pyridine ring substitution.
(2) Change of R from a hydrogen atom to a phenyl radical.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

(3) Change of R' from a phenyl radical to an alkyl radical.
(4) Change of M from lithium to sodium.
(5) Changes in molar ratio of metalated tar base to ester from 2:1 to 1:1.
(6) Change of solvent used in the reaction.
(7) Change in condensing agent from C_6H_5M to $MN(i\text{-}C_3H_7)_2$.

The effects of these factors have been rationalized in terms of the suggested mechanism.

The relative amounts of ketone and carbinol which are obtained in the acylation of 2-picoline and 2-benzylpyridine with ethyl benzoate and aliphatic esters may be changed over wide limits depending on the factors listed above.

The following ketones were prepared by the reaction of 3-picoline with ethyl benzoate and aliphatic esters using sodium diisopropylamide in benzene as the condensing agent: $3\text{-}C_5H_4NCH_2COC_6H_5$ (78%), $3\text{-}C_5H_4NCH_2COCH_3$ (47%), $3\text{-}C_5H_4NCH_2COCH_2CH_3$ (61%), $3\text{-}C_5H_4NCH_2COCH(CH_3)_2$ (69%), and $3\text{-}C_5H_4NCH_2COC(CH_3)_3$ (79%).

It was found that 4-picoline and 4-benzylpyridine could also be acylated with ethyl benzoate and aliphatic esters to give good to excellent yields of the expected ketones using sodium diisopropylamide as the condensing agent.

The alkylation of 2-, 3- and 4-picoline with beta-dimethylaminoethyl chloride using various condensing agents under various conditions gave the expected products in fair to excellent yields. These tar base derivatives, 2-, 3- and $4\text{-}C_5H_4NCH_2CH_2CH_2N(CH_3)_2$, were acylated with ethyl benzoate and aliphatic esters in fair to excellent yields using sodium diisopropylamide as the condensing agent.

The alkylation of 2- and 4-benzylpyridine with beta-dimethylaminoethyl chloride using various condensing agents under various conditions gave good to excellent yields of the tar base derivatives, 2- and $4\text{-}C_5H_4NCH(C_6H_5)CH_2\text{-}CH_2N(CH_3)_2$. The acylation of $2\text{-}C_5H_4NCH(C_6H_5)CH_2CH_2\text{-}N(CH_3)_2$ (Trimeton) with ethyl benzoate and aliphatic esters using phenyllithium in ether as the condensing agent gave good yields of the expected ketones.

Microfilm $2.20; Xerox $7.80. 168 pages.

METALATION AND HYDROGENATION REACTIONS OF PYRIDOTETRAZOLE AND METHYLPYRIDOTETRAZOLES.

(L. C. Card No. Mic 59-4203)

Ronald Fabian Reinisch, Ph.D.
Tulane University, 1959

Chairman: J. H. Boyer

The pyridotetrazole synthesis of Boyer has been extended to the synthesis of the methylpyridotetrazoles. On the basis of chemical evidence and confirmatory spectrophotometric studies, it has been shown that pyridotetrazole and 6-methylpyridotetrazole lithiates in the 5- and 8-positions. A methyl group in the 5- position of pyridotetrazole undergoes lateral metalation to yield upon carbonation 5-pyridotetrazolylacetic acid. In the case of 7-methylpyridotetrazole, monolithiation occurred to give 8-carboxy-7-methylpyridotetrazole. Nuclear metalation occurred at the 5-position of 8-methylpyridotetrazole to give 5-carboxy-8-methylpyridotetrazole.

The side-chain oxidation of the methylpyridotetrazoles gave the corresponding carboxypyridotetrazoles. These compounds were employed in the structural elucidation studies and served as model compounds for the spectrophotometric studies.

The presence of a tetrazole ring gives rise to absorption in the infrared in the region 1098-1087 cm^{-1}. The assignment of this absorption to the tetrazole ring modes of vibration is confirmed by the data of other investigators. The correlation between absorption bands in the infrared region above 900 cm^{-1} and the number and position of substituents on an aromatic ring has been extended to the pyridotetrazole ring system.

Mixed melting point measurements were not a useful criterion for the identification of substituted pyridotetrazoles since these compounds often fail to show melting point depression upon admixture with an isomeric pyridotetrazole derivative.

The catalytic low pressure hydrogenation of pyridotetrazole in acidic media has been shown to lead to the formation of tetramethylenetetrazole. When the hydrogenation was carried out in basic media, 2-aminopyridine was formed exclusively.

Microfilm $2.00; Xerox $5.60. 113 pages.

THE REACTION OF VARIOUS OLEFINS WITH AZODICARBOXYLIC ESTER AND MALEIC ANHYDRIDE.

(L. C. Card No. Mic 59-4977)

Robert Eugene Rinehart, Ph.D.
University of Michigan, 1959

Although the addition of dienophiles to olefins has been known for some time, the mechanism has not been clearly established.

Azodicarboxylic ester was known to react with olefins under mild conditions, but structure proofs in the literature were few and inconclusive. Adducts of selected olefins were thus prepared, and the positions of the double bonds were established. Structure proofs of the adducts from hexene-1, octene-1, and octene-2 showed that the double bond had migrated during addition. The adduct from decene-5 was ozonized, and the volatile components were separated by gas phase chromatography. The results indicated that 100% migration of the double bond had occurred. The reaction of azodicarboxylic ester with olefins thus can be considered analogous to those of maleic anhydride, which also forms adducts accompanied by migration of the double bond.

The importance of an ionic mechanism for the addition was investigated by the use of olefins prone to undergo carbonium-ion rearrangements. No evidence of reaction of norbornylene with maleic anhydride could be obtained until the reactants were heated to a temperature at which the norbornylene decomposed. Azodicarboxylic ester was also inert towards norbornylene, reacting only at elevated temperatures, to give mainly decomposition products.

tert-Butylethylene was inert toward azodicarboxylic ester and maleic anhydride except at very high temperature. At 300°, only a small amount of 1:1 adduct was found for the maleic anhydride reaction. The extreme conditions required for norbornylene and tert-butylethylene suggest

that the normal addition reaction is prevented with these two olefins.

2,3,3-Trimethylbutene-1, which is structurally similar to tert-butylethylene except for the methyl group on the double bond, added easily under normal conditions to both dienophiles. Trimethylbutene would be able to add by a cyclic mechanism, which would be structurally impossible with norbornylene and tert-butylethylene, and the evidence thus suggests that the cyclic mechanism is preferred.

The pseudo-first-order reaction of azodicarboxylic ester in excess olefin was studied spectrophotometrically. Branching of the olefin chain accelerated the rate, as did the presence of an aromatic ring. The effect of branching might be considered to be consistent with the cyclic mechanism, since there are more alpha-hydrogens available for the formation of the cyclic complex.

Several results from the investigation indicate that free radicals initiate a side reaction, leading to polymerization at the expense of adduct formation.

Microfilm $2.00; Xerox $6.20. 129 pages.

DECANDROLONIC ACID: ITS ISOLATION AND PARTIAL CHARACTERIZATION.

(L. C. Card No. Mic 59-4175)

Donald L. Roberts, Ph.D.
Purdue University, 1959

Major Professor: James H. Brewster

In the course of investigating the anti-cancer activity of Phytolacca decandra (poke weed) seeds, a mixture of glycosides was isolated which could be hydrolyzed to an aglycone, decandrolonic acid. A study of decandrolonic acid was undertaken to determine its structure.

The material analyzed for formulae of either $C_{25}H_{40}O_6$ or $C_{25}H_{38}O_6$; the oxygen atoms were identified as being present in a carboxyl group, a hindered ketone, two hydroxy groups and a methyl ether. The results of a series of color tests indicated decandrolonic acid might be a steroid; this suggestion was supported by the lack of aromaticity and any quantity of unsaturation in the compound.

Some evidence as to the type of steroid which might be present was given by the selenium dehydrogenation and Wolff-Kishner reactions of decandrolonic acid. The dehydrogenation gave a small amount of unpurifiable product which had an ultraviolet spectrum characteristic of an aromatic condensed ring compound, and in particular, methyl cholanthrene. The Wolff-Kishner reduction using the Huang-Minlon procedure did not give reduction, but instead gave a condensation reaction. The product apparently arose from the condensation of the carbonyl with the hydrogens alpha to the carboxyl and elimination of the methoxy group to give a pentacyclic diene. A 12-ketocholanic acid type structure would appear to be necessary to obtain products of these types. This theory is supported by the large positive optical rotation of decandrolonic acid.

The presence of a double bond in decandrolonic acid is somewhat uncertain. The nuclear magentic resonance spectra of methyl decandrolonate and methyl decandrolonate diacetate had a peak in the vinyl hydrogen region. Although the presence of a double bond would aid in the explanation of many of the reactions of decandrolonic acid, the analyses and the qualitative tests tend to indicate that no double bond is present. The infrared spectra suggested that if a double bond is present, it may be conjugated with the carboxyl group. The oxidation of the acid gave products which, under mild conditions, appeared to result from the hydroxylation of a double bond and, under more vigorous conditions, to result from the elimination of the methoxy group followed by cleavage of a double bond.

In an attempt to clarify the structure of the presumed acid side chain, a Barbier-Wieland degradation was attempted. A phenyl ketone was isolated in both the Barbier-Wieland and the Barbier-Wieland-Miescher degradations. This suggests that the carboxyl group is hindered to the extent that only one mole of phenyl magnesium bromide can be added. This hindrance is also shown by the difficulty in esterification of decandrolonic acid and in the resistance of the ester to saponification.

The data suggest a 12-ketocholanic acid type structure for decandrolonic acid. The double bond, if present, appears to be in the side chain, and the methoxy group at the 17 position. One of the hydroxy groups is probably at position 3, but the location for the other hydroxy group is unknown. The structure postulated must be considered as only a tentative basis for further work.

Microfilm $2.00; Xerox $5.40. 107 pages.

A STUDY OF THE FACTORS CONTROLLING OXYGEN AND NITROGEN ATTACK IN OXIME ALKYLATION.

(L. C. Card No. Mic 59-4978)

Jerry Earl Robertson, Ph.D.
University of Michigan, 1959

The purpose of this research is to obtain comprehensive and accurate data for oxime alkylations to contribute to the development of a satisfactory theoretical picture for this class of ambident ion alkylation. The effect on the ratio of products of systematic variations of the oxime and alkyl halide, the basicity of the reaction mixture, the nature of the leaving group, the cation, the solvent, and the reactant concentrations are studied.

The alkylations are usually performed in a strongly basic medium to insure virtually complete ionization of the oxime. Product mixtures are separated by chromatography and the ratio of oxygen-to-nitrogen alkylation determined. In nearly every case, 100 $\pm$ 4% of the material involved in each reaction is accounted for. Generally, standard errors of $\pm$0.2 are assigned to the product ratios.

Benzylations of symmetrically substituted benzophenone oximes give increasing oxygen-to-nitrogen product ratios with increasingly strong electron-withdrawing substituents (2.4 $\pm$ 0.1 for p,p'-dimethoxybenzophenone oxime to 21 $\pm$ 3 for p,p'-dinitrobenzophenone oxime). Similar results are obtained for methylations. When variously substituted benzyl bromides are used under otherwise identical conditions, the oxygen-to-nitrogen ratio also increases with increasingly strong electron-withdrawing substituents (2.0 $\pm$ 0.2 for p-methoxybenzyl bromide to 3.8 $\pm$ 0.3 for p-cyanobenzyl bromide).

Benzylation of benzophenone oxime without a base or

solvent present gives predominantly N-alkylation, but the reaction is very slow. Alterations of the base, changes in the initial reactant concentrations, and addition of a common ion usually result in only small product ratio changes. Variations of the reaction solvent and of the leaving group produce larger, but difficult to interpret, changes in the product ratio.

The product ratio is interpreted to be controlled by the relative nucleophilicities of the nitrogen and oxygen in oximate ion, since a competition between these two nucleophilic centers is postulated. The applicability and validity of previously proposed rationales for reactions of this general type is discussed.

Microfilm $2.00; Xerox $5.20. 102 pages.

THE MECHANISM OF REDUCTION OF AROMATIC COMPOUNDS BY LITHIUM IN METHYLAMINE.

(L. C. Card No. Mic 59-4177)

Patrick W. Ryan, Ph.D.
Purdue University, 1959

Major Professor: Dr. Robert A. Benkeser

The Mechanism of Reduction of Aromatic Compounds by Lithium in Methylamine.

The reduction of aromatic amines by the lithium-amine system led to the formation of relatively large amounts of cyclohexylamine. The loss of the customary selectivity of this reagent in effecting reductions of primary and secondary aromatic amines to the tetrahydro stage has been traced to a facile reduction of the 1-aminocyclohexenes via an imine derivative, as well as a 1,2 reduction of the intermediate 3 and 4-aminocyclohexenes. Tertiary aromatic amines were reduced to mixtures of cyclohexanone and cyclohexylamines in the presence of excess lithium. Here also, it was shown that the cyclohexylamines resulted from a 1,2 reduction of the intermediate and 3 and 4-aminocyclohexenes. The cyclohexanone resulted from hydrolysis of the 1-dialkylaminocyclohexene. It was also demonstrated that 1-dialkylaminocyclohexenes were not reduced in this system and that 3-dimethylaminocyclohexene could not be hydrolyzed to cyclohexanone.

Reduction of a series of alkylbenzenes indicated the presence of all three isomeric alkylcyclohexenes in the product when analysis was carried out with gas chromatography. With an excess of lithium, as well as longer reaction time, a preferential reduction of the 3 and 4-alkylcyclohexenes was achieved to produce alkylcyclohexanes.

To account for the presence of all three isomeric alkylcyclohexenes in the reduction products a mechanism was proposed which involved: (1) an initial 1,4 reduction of the aromatic ring, (2) establishment of a complex equilibria between conjugated and unconjugated dihydroalkylbenzenes, and (3) a final 1,4 addition of electrons to the various conjugated dihydroalkylbenzenes followed by stepwise protonation.

Evidence for the first step was obtained when the intermediate 2,5 dihydroalkylbenzene was trapped by carrying the reduction out in the presence of the strong acid ethanol. Information concerned with the postulated complex equilibria was gained through a study of the isomerizations of 1,2 and 2,5 dihydrocumene by lithium methylamide in methylamine, as well as reduction of various dihydroalkylbenzenes in the presence or absence of lithium methylamide. Evidence for the final step was obtained from the reduction of conjugated dihydroalkylbenzenes by lithium in methylamine.

A study of the reduction of alkylcyclohexenes in this system was carried out.

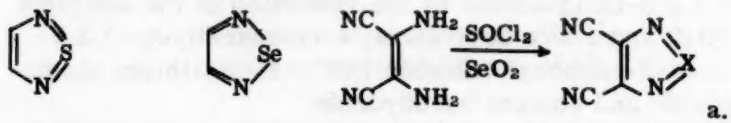
Microfilm $2.00; Xerox $5.80. 120 pages.

DERIVATIVES OF 1,2,5-THIADIAZOLE AND 1,2,5-SELENADIAZOLE.

(L. C. Card No. Mic 59-4037)

Daniel Shew, Ph.D.
Indiana University, 1959

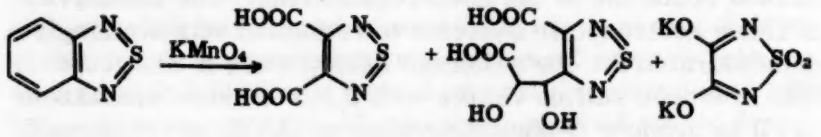
The synthesis of the 3,4-dicyano derivatives (Ia and b) of the novel heterocyclic compounds, 1,2,5-thiadiazole (II) and 1,2,5-selenadiazole (III), has been accomplished by the reaction of hydrogen cyanide tetramer (2,3-diaminomaleonitrile, IV) with thionyl chloride and selenium dioxide, respectively. The oxidation



II III IV I

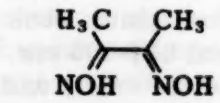
a. X = S
b. X = Se

of 2,1,3-benzothiadiazole (V) with potassium permanganate has been found to give 1,2,5-thiadiazole-3,4-dicarboxylic acid (VI). Two by-products have been isolated from this reaction, and evidence was obtained in support of their formulation as VII and VIII.

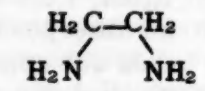


V VI VII VIII

Several potential routes to monocyclic derivatives of 1,2,5-thiadiazole were investigated. Reactions involving the ring closure of dimethylglyoxime (IX), ethylenediamine (X), and N,N'-diacyl-cis-vinylenediamines (XI) were unsuccessful. Oxidation of 2,1,3-benzothiadiazoles possessing electron-donating substituents (5,6-dimethoxy-2,1,3-benzothiadiazole, XII) also did not yield the desired products.



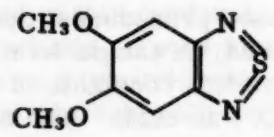
IX



X



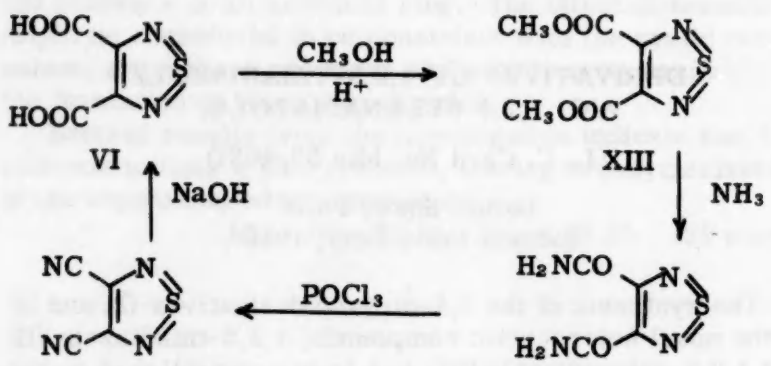
XI



XII

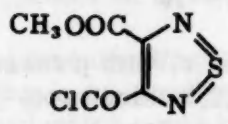
The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

The three-step conversion of 1,2,5-thiadiazole-3,4-dicarboxylic acid (VI) to the corresponding dinitrile (Ia) provides evidence in support of the assignment of structures of the two compounds. The hydrogen chloride-catalyzed reaction of the diacid (VI) with methanol gives the dimethyl ester (XIII) in good yield. Anhydrous ammonia in methanol acts on the dimethyl ester to form the diamide derivative (XIV). The dinitrile is prepared by the dehydration of the diamide, XIV, by means of phosphorus oxychloride. Reconversion of the dinitrile to the diacid (VI) was achieved by boiling the nitrile with sodium hydroxide in aqueous ethanol.



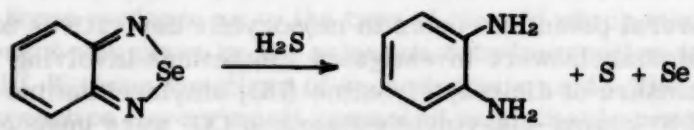
Ia. XIV

Several attempts were made to prepare methylol-substituted 1,2,5-thiadiazoles by the reduction of the dimethyl ester (XIII) and a new derivative, 4-carbomethoxy-1,2,5-thiadiazole-3-carbonyl chloride (XV). Both lithium aluminum hydride and sodium borohydride



XV

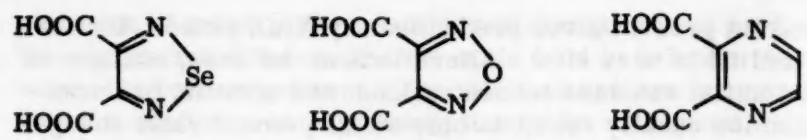
caused reduction of the heterocyclic ring. The sensitivity of these heterocyclic systems to reduction was strikingly demonstrated for the selenium analog when it was found that hydrogen sulfide reacts with 2,1,3-benzoselenadiazole (XVI) to produce o-phenylenediamine (XVII) and elemental selenium.



XVI XVII

The 1,2,5-thiadiazole ring is characterized by intense ultraviolet absorption in the region 260-275 mμ. In the infrared region, 1,2,5-thiadiazole derivatives exhibit weak to medium absorption at 762-793 cm.$^{-1}$ and 844-875 cm.$^{-1}$ These bands are apparently independent of the extent and type of ring-substitution.

Alkaline hydrolysis of the dinitrile (Ib) afforded 1,2,5-selenadiazole-3,4-dicarboxylic acid (XVIII). By means of published procedures, the oxygen analog (XIX) was also prepared. A comparison of the ultraviolet spectra and acid dissociation constants of the compounds VI, XVIII, XIX, and XX was made. The study was carried out as an extension of earlier work in this laboratory, in which



XVIII XIX XX

2,1,3-benzothiadiazole (V) and quinoxaline (XXI) were shown to exhibit remarkable similarities, but benzoxadiazole (XXII) was found to be considerably different from the other two heterocyclic compounds. The basis in electronic valence concepts for the



XXI XXII

experimentally observed similarity of the -S-, -Se-, and the -C=C- groups in heterocyclic systems is discussed. The reasons for the non-equivalence of -O- to the other three groups are also considered.

Microfilm $2.00; Xerox $7.20. 152 pages.

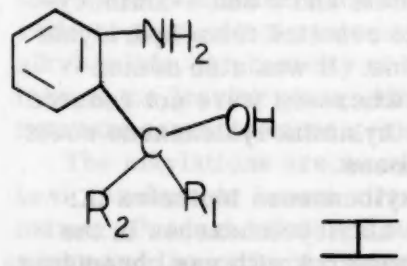
THE 1,3-REARRANGEMENT OF o-AMINOPHENYLCARBINOLS.

(L. C. Card No. Mic 59-4987)

Anthony Joseph Sisti, Ph.D.
University of Michigan, 1959

The recent report that tribenzotropone could be isolated from the deamination of 9-o-aminophenyl-9-fluorenol prompted an investigation of similar o-aminophenylcarbinols. The aim was to determine whether such 1,3-rearrangements were common in these systems and what structural factors influenced the rearrangement.

Fourteen o-aminophenylcarbinols with the structural features shown, I, were synthesized.



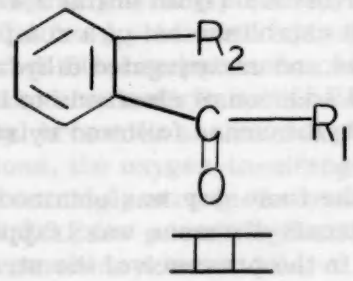
R$_1$ = Methyl, Ethyl or Aryl

R$_2$ = Aryl

I

The synthesis was accomplished by reaction of methyl anthranilate with an aryl Grignard reagent or by treatment of the corresponding o-amino ketone with the methyl or ethyl Grignard reagent.

Each of the above-mentioned compounds was diazotized



II

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in acidic aqueous medium at 0-5° C; nitrous acid was employed as the diazotizing agent. The diazonium salt thus produced was decomposed to produce a phenol, a fluorenol (intramolecular cyclization), and a ketone, II (1,3-rearrangement). In order to separate the three major products, column chromatography was used with alumina as the adsorbent.

The yields of ketones isolated from the deamination reaction ranged from 0% to 28%. The structures of four ketones thus isolated were unequivocally proven by synthesis; each possessed the structure shown in II. From the results of the study it was concluded that the ketone was produced in substantial amounts only when fluorenol formation was impeded because of steric hindrance. A detailed discussion of this steric effect is presented. If the above-mentioned steric effect was present, only then was an electrical effect observed which affected the yield of ketone. A detailed mechanism consistent with the above-mentioned facts is presented.

When 1-o-aminophenyl-1-(2,5-dimethyl-4-methoxyphenyl)-ethanol was deaminated, in addition to all the expected products, 2-acetyl-2',5'-dimethyl-4'-methoxyazobenzene was isolated. The azo ketone was believed to arise from an intramolecular coupling reaction. An intermolecular application of this reaction led to a new and convenient synthesis of aliphatic and aromatic aldehydes. Specifically, it involved cleavage of various p-dimethylaminophenyl alcohols by a diazonium salt resulting in the production of an azo compound and an aldehyde. A total of nine aldehydes were synthesized and the yields of distilled product ranged from 60-80%.

Microfilm $2.00; Xerox $5.20. 101 pages.

THE SYNTHESIS OF CERTAIN AROMATIC KETO ESTERS THROUGH UTILIZATION OF 3-CARBOMETHOXYBENZOYL CHLORIDE.

(L. C. Card No. Mic 59-4746)

Roy Windham Sonntag, Ph.D.
The University of Texas, 1959

Supervisor: Professor Henry R. Henze

Probably, the method at present most widely used for the preparation of a mixed ketone involves interaction of an acid chloride and a dialkylcadmium reagent. One of the most important applications of this reaction has been in the preparation of aliphatic keto esters and keto acids. The utilization of 3-carbomethoxybenzoyl chloride with dialkylcadmium reagents is the initial account of the synthesis of aromatic keto esters and keto acids by this method.

An improved method for the preparation of methyl hydrogen isophthalate has been developed. The conversion of methyl hydrogen isophthalate into 3-carbomethoxybenzoyl chloride has been described.

The interaction of 3-carbomethoxybenzoyl chloride with seven dialkylcadmium compounds has produced methyl 3-ethanoylmethyl 3-propanoyl-, methyl 3-butanoyl-, methyl 3-pentanoyl-, methyl 3-(3-methylbutanoyl)-, methyl 3-hexanoyl-, and methyl 3-(4-methylpentanoyl)benzoates. The failure of a secondary dialkylcadmium compound to condense with 3-carbomethoxybenzoyl chloride has been noted. Acid and basic hydrolyses of these aromatic keto esters has resulted in the formation of six new 3-acylbenzoic acids. This synthesis has developed a means to prepare, in satisfactory yields, certain bifunctional meta-disubstituted benzene derivatives which would be difficult to achieve by other synthetic routes.

The carbonyl character of the aromatic keto esters has been verified by semicarbazone formation. Also, the carbonyl function was found to undergo the Bucherer reaction, resulting in formation of 5-alkyl-5-(3-carboxyphenyl)hydantoins. The conditions of the Bucherer reaction have been shown to bring about aroyl ester cleavage. Previous work has indicated that aliphatic ester cleavage does not occur when aliphatic keto esters are utilized in this reaction. Employment of methyl 3-butanoylbenzoate in the Pfitzinger reaction has produced 2-(3-carboxyphenyl)-3-ethylcinchoninic acid.

Microfilm $2.00; Xerox $4.80. 93 pages.

THE SYNTHESIS AND REACTIONS OF 5-PHENYL-2-ISOXAZOLINE-3-CARBOXYLIC ACID AND RELATED COMPOUNDS.

(L. C. Card No. Mic 59-4991)

John Lawrence Spencer, Ph.D.
University of Michigan, 1959

The purpose of this research was to investigate the chemistry of 2-isoxazolines, especially those which have functional groups in the 3-position. The fact that a 3-isoxazolidinone isolated from natural sources has been found to possess antibiotic activity gives added importance to the study of this heterocyclic ring.

The proposed attack on the problem was: 1) synthesis of 5-phenyl-2-isoxazoline-3-carboxylic acid, 2) conversion by a Curtius degradation to 3-amino-5-phenyl-2-isoxazoline, and 3) conversion to 3-hydroxy-5-phenyl-2-isoxazolines. In addition to these 5-phenyl-2-isoxazolines with a functional group in the 3-position, the synthesis of functionally substituted analogs was proposed.

The first method of synthesis for 5-phenyl-2-isoxazoline-3-carboxylic acid to be investigated was the reaction of benzylidenepyruvic acid and hydroxylamine. The expected isoxazoline was not found in this investigation, but the desired acid was synthesized by hydrolysis of the product obtained by the addition of carbethoxyformonitrile oxide to styrene. A Curtius degradation then gave the desired 3-amino-5-phenyl-2-isoxazoline. Conversion to the 3-hydroxyl derivative was expected on hydrolysis, but the amine was stable to basic hydrolysis and yielded trans-cinnamic acid on acidic hydrolysis. Other methods of conversion were investigated, including deamination with nitrous acid, a Sommelet type reaction and a Bucherer reaction, but all were abortive.

Other means of preparing 3-hydroxy-5-phenyl-2-isoxazoline from 2-isoxazolines obtained in this research were investigated without successful synthesis. These include a Hunsdiecker silver salt reaction on 5-phenyl-2-isoxazoline-3-carboxylic acid, cleavage of this acid with lead tetraacetate or periodic acid, and similar cleavage of dimethyl-3-(5-phenyl-2-isoxazoline)-methanol, which was

obtained by a Grignard reaction on the ester of this acid.

The addition of carbethoxyformonitrile oxide to several olefins with functional groups was tried. No isoxazoline was obtained with cinnamic acid or several of its derivatives. However, this nitrile oxide added to methyl styrylcarbamate to yield a 2-isoxazoline with a functional group in addition to the carbethoxy group in the 3-position. A Curtius reaction on this adduct gave a diurethan which could not be hydrolyzed to either a mono- or diamine.

Microfilm $2.00; Xerox $4.40. 82 pages.

PREPARATION OF POLY(PHENYL ETHERS).

(L. C. Card No. Mic 59-4660)

Gerald David Staffin, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Charles C. Price

The preparation of poly(phenylene oxides) has been attempted by four methods.

1. Pyrolysis of metal salts of halophenols in the presence of copper powder.
2. Attempt to prepare benzyne oxide which then would be polymerized.
3. Attempt to prepare benzene diazo oxide which would be irradiated to form polymer.
4. Catalytic oxidation of appropriate 2,4,6-trisubstituted metal salts of phenols.

The last method was successful and gave polymers softening at 200-240° C. Most polymerization studies were carried out on salts of 2,6-dimethyl-4-bromophenol. The polymerization method generally used was to add less than five mole percent of a one-electron oxidizing catalyst, such as lead dioxide, lead tetraacetate, potassium ferricyanide, silver oxide, benzoyl peroxide to an alkali metal salt of the phenol partitioned between aqueous and organic phases. The mixture was agitated at or below room temperature to give yields from 40 to 90 percent of polymer.

The cohesive energy density of the polymer was established using non-hydrogen bonded solvents. The polymer was fractionated using ethylene dichloride as solvent and nitromethane as non-solvent. The intrinsic viscosities of the fractions were determined in benzene. The molecular weights of the polymer fractions were determined from bromine end group analyses and by non-aqueous titration of the phenolic end group. The molecular weights obtained by these methods agreed. The constants, K and α, in the equation, $\eta = KM^{\alpha}$ were determined using the molecular weights and viscosities of the polymer fractions. The molecular weights of the polymer fractions ranged from 2000 to 10,000.

Thermal stability tests on the polymer indicated that it was stable to 320° C.

It is proposed that the initiation step of the polymerization is a one-electron oxidation of the phenoxide ion to the phenoxy radical. The propagation step can be represented by the overall loss of bromide ion and the substitution of a phenoxy group at the carbon which lost the bromine to give a new phenoxy radical. The exact nature of the termination reaction is not known but it is known that the ratio of bromine to phenolic hydroxyl is one, so this reaction may be represented by the destruction of the phenoxy radical by abstraction of a hydrogen from solvent, monomer, or polymer to give a phenol end group and a new radical.

Microfilm $2.05; Xerox $7.40. 156 pages.

d- AND l-POLYCONIDINE, AN ISOTACTIC POLYAMINE.

(L. C. Card No. Mic 59-4671)

Madeline Shen Toy, Ph.D.
University of Pennsylvania, 1959

Supervisor: Charles C. Price

The aim of this study was to polymerize optically-active conidines. Conidine is a bicyclic amine related to quinuclidine. Its systematic name is 1-azabicyclo(4,2,0)octane. Since conidine prior to polymerization contains an asymmetric carbon away from the reaction center, the polyconidines thus prepared should be isotactic polyamines. A further purpose of this research was to explore the applications of optically-active resins prepared from isotactic polyconidines.

dl-2(β-Hydroxyethyl)piperidine was resolved by d-10-camphorsulfonic acid. dl-2-(β-Hydroxyethyl)piperidine-d-10-camphorsulfonate, m.p. 124°, was fractionated into the dd'-salt, m.p. 168°, and the ld'-salt, m.p. 142°, by a combination of careful fractional crystallization and mechanical separation. Alkali liberated the d- and l-forms of the free base, m.p. 69°, $[\alpha]_D \pm 11.0°$ (dl-, m.p. 44°). By treating a chloroform solution first with dry hydrogen chloride and then thionyl chloride, 56-94% yields of 2-(β-chloroethyl)piperidine hydrochloride were obtained; dl-, m.p. 165°, d- and l-, m.p. 214°, $[\alpha]_D \pm 8.5°$. These salts were converted to conidine in 35-59% yield by aqueous sodium hydroxide, b.p. 135°, $[\alpha]_D \pm 71°$ (dl-, b.p. 144°).

Polymerization of the d-isomer with boron fluoride rapidly gave white poly-d-conidine boron fluoride, m.p. 75°, $[\alpha]_D + 13°$, $[\eta]$ 0.05, Molecular weight 4300 (Rast method, 24 repeating units). Much better results were obtained with boron fluoride etherate, which gave good yields of polymer in a week or two at room temperature: d- and l-(isotactic), m.p. 94°, $[\alpha]_D \pm 140°$, $[\eta]$ 0.35 - 0.45; mixture of d- and l-, m.p. 93°, $[\alpha]_D$ zero; dl-(atactic), soft and tacky at room temperature, unless the concentration of catalyst was markedly decrease, when polymer separable into seven solid fractions was obtained. These turned from opaque to clear at room temperature ranging from 123° to less than 30° and had intrinsic viscosities from 0.63 to less than 0.2. The molecular weights of these various fractions were estimated from intrinsic viscosities by the equation $[\eta] = 1.03 \times 10^{-4} M^{0.74}$. An ionic mechanism was suggested for polymerization of conidine by boron fluoride etherate.

The d- and the coprecipitated mixture of d- and l-isotactic polymers gave different but sharply crystalline X-ray powder diagrams.

Optically-active resins were prepared by crosslinking isotactic polyconidines with pentamethylene dibromide. The latter served as a crosslinking agent which, through

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quaternary ammonium bromide linkages with the tertiary amine nitrogens of polyconidines, converted the linear polymer to a three-dimensional network. However, a dibromide of shorter alkyl chain, ethylene dibromide, was apparently unable to crosslink the two linear chains, perhaps for steric reasons. When the dibromide of a longer alkyl chain, 1,5-dibromopentane, was used to crosslink the polyconidine chains at 80° in chloroform, an insoluble resin, as predicted for a three-dimensional polymer, was formed. This weakly basic bromide ion resin was then treated with 10% sodium hydroxide solution at room temperature to displace all the bromide ions to form the strongly basic hydroxide ion resin. The combined filtrate and washings were analyzed for the total bromide ion content to confirm this displacement reaction.

Attempted resolution of racemic mandelic acid and induced asymmetric aldol condensation of butyraldehyde by this optically-active quaternary hydroxide resin were unsuccessful. Microfilm $2.00; Xerox $3.60. 61 pages.

THE SYNTHESIS OF SOME 11H-INDENO(1,2-b)QUINOXALIN-11-ONE AND 6H-INDOLO(2,3-b)QUINOXALINE COMPOUNDS AS POTENTIAL ANTIMETABOLITES.

(L. C. Card No. Mic 59-4672)

Rocco Peter Triolo, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Allan R. Day

The syntheses of some 11H-indeno(1,2-b)quinoxalin-11-one and 6H-indolo (2,3-b)quinoxaline compounds were the main objectives of this investigation. They were expected to inhibit natural processes by chelation with metalic ions or by acting as riboflavin antagonists.

7(8)-substituted 11H-indeno(1,2-b)quinoxalin-11-one compounds were prepared by the condensation of 4-substituted-o-phenylenediamines and ninhydrin in warm methanol.

A number of disubstituted 11H-indeno(1,2-b)quinoxalin-11-one compounds were prepared by the condensation of the appropriate disubstituted-o-phenylenediamine with ninhydrin in warm methanol. Among the disubstituted compounds prepared were those containing substituents in the same positions relative to the ring nitrogens as the methyl groups in riboflavin.

The oximes and thiosemicarbazones were also prepared.

2(3)-substituted 6H-indolo(2,3-b)quinoxaline compounds were prepared by condensing 4-substituted-o-phenylenediamines and isatin in boiling 50% aqueous acetic acid.

Disubstituted-o-phenylenediamines were condensed with isatin in hot 50% aqueous acetic acid to yield disubstituted 6H-indolo(2,3-b)quinoxalines.

Solutions of 6,9 disubstituted 11H-indeno(1,2-b)quinoxalin-11-one compounds, with electron donor groups (methoxy-, hydroxy-), when tested with a number of salt solutions, demonstrated their chelating ability.

Solutions of 1,4-disubstituted 6H-indolo(2,3-b)quinoxaline compounds also gave positive chelating tests when treated with salt solutions.

Due to the chelating ability of the disubstituted members of each ring system, these compounds may possibly act as enzyme inhibitors. They may also compete with proteins for metalic ions, which are essential for enzyme formation and thereby inhibit (either partially or completely), enzyme formation.

The members of the indenoquinoxaline and indoloquinoxaline ring systems could also possibly act as riboflavin antagonists. It has been demonstrated that these compounds could be hydrogenated and, therefore, could act as hydrogen traps, thereby interfering with the normal hydrogen transfer activity of riboflavin.

Microfilm $2.00; Xeroc $5.40. 106 pages.

FACTORS WHICH INFLUENCE CARBON-TO-NITROGEN MIGRATION OF AROMATIC GROUPS IN THE SCHMIDT REARRANGEMENT AND VON BRAUN-RUDOLPH TETRAZOLE SYNTHESIS.

(L. C. Card No. Mic 59-5010)

Roger Dean Westland, Ph.D.
University of Michigan, 1959

This investigation is devoted to a study of some of the factors which influence the relative migrational tendencies of aromatic groups in the Schmidt reaction of ketones. To this end, the application of the Schmidt reaction to 1-, 2-, 3-, and 9-benzoylphenanthrene is described. The results of the Beckmann rearrangement of the corresponding equilibrated oximes are presented for comparison. The use of the various phenanthryl groups in this work supplements the available data by providing strongly electron-donating groups in both sterically symmetrical (p-substituted benzophenone type) and sterically unsymmetrical (o-substituted benzophenone type) aromatic ketones. The 2- and 3-positions of phenanthrene are sterically unhindered in the neighborhood of the carbonyl group, whereas the 1- and 9-positions are hindered. In both reactions the composition of the mixed amides isolated as products was determined by infrared spectroscopy.

Beckmann rearrangement studies on 2- and 3-benzoylphenanthrene oxime show that the isomeric oximes of both compounds were formed in a 1:1 statistical ratio. However, in the Schmidt reaction there is indicated slightly preferential phenanthryl group migration. This result is contrary to the 1:1 ratios generally obtained for para-substituted benzophenones. Both 1- and 9-benzoylphenanthrene exhibit preferential phenyl group (less bulky) migration in the Schmidt reaction and Beckmann rearrangement of the oximes; however, there is considerably less phenyl group migration in the Schmidt reaction than in the Beckmann rearrangement of these compounds.

The differences in the ratios of products from these two reactions suggest that in the Schmidt reaction of the isomeric benzoylphenanthrenes the rate of interconversion of the proposed syn and anti iminodiazonium ion intermediates approximates the rate of migration of the aryl groups, providing a path for migratory aptitudes to have an effect. This explanation has previously been proposed to explain the preferential p-anisyl group migration in the Schmidt reaction of p-methoxybenzophenone.

A study is described whereby the occurrence of ureas and disubstituted 5-aminotetrazoles in the Schmidt reaction of certain ketones and in some von Braun-Rudolph tetrazole syntheses is better understood. Since the imidyl azide intermediate in the von Braun-Rudolph reaction is probably identical to the species which provides similar side products in the Schmidt reaction, conditions which facilitate side products in one probably will do the same in the other case. Hence, the tendency of variously substituted N-phenylbenzimidyl chlorides to provide ureas or aminotetrazoles in the von Braun-Rudolph tetrazole synthesis is described.

Side reactions are reported from the following imidyl chlorides in order of decreasing yields of rearrangement products (ureas and aminotetrazoles): N-phenyl-o-toluimidyl chloride > N-phenyl-o-iodobenzimidyl chloride > N-(o-tolyl)-p-anisimidyl chloride > N-phenyl-o-chlorobenzimidyl chloride > N-(o-tolyl)-benzimidyl chloride, N-(2, 6-dimethylphenyl)-benzimidyl chloride. Experiments are also described which show that N-phenyl-1-phenanthrimidyl chloride rather than the isomeric N-(1-phenanthryl)-benzimidyl chloride is responsible for side product formation in a von Braun-Rudolph reaction involving a mixture of the two imidyl chlorides.

From the imidyl chloride-hydrogen azide reactions which were studied, it is concluded that rearrangement competes noticeably with cyclization to tetrazole if the phenyl group attached to carbon of the imidyl chloride is ortho-substituted, and that electrical effects exert an influence. Electrical effects alone seem to play only a minor role and the rearrangement reaction is strongly enhanced by hydrogen chloride.

Microfilm $2.00; Xerox $6.00. 121 pages.

A STUDY OF SOME NAPHTHOQUINONE IMIDAZOLES AND SOME DERIVATIVES OF P-BENZOQUINONE.

(L. C. Card No. Mic 59-4674)

James Myers Wilbur, Jr., Ph.D.
University of Pennsylvania, 1959

Supervisor: Allan R. Day

The work presented in this thesis concerns: (1) Synthesis of some 2-substituted-4,9-naphth (2,3) imidazolediones; (2) Synthesis of some 5-substituted-4,9-naphth (2,3) imidazolediones and (3) Synthesis of some derivatives of p-benzoquinone.

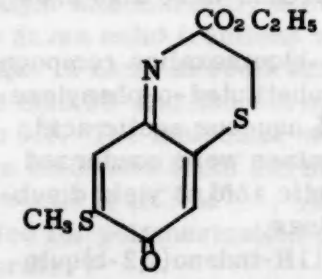
I. Synthesis of 2-Substituted-4,9-naphth (2,3) imidazolediones. Amination of 2,3-dichloro-1,4-naphthoquinone yields 2-amino-3-chloro-1,4-naphthoquinone. Acylation of this amino compound with various acid chlorides including lauroyl chloride, palmityl chloride, cinnamoyl chloride, chaulmoogroyl chloride, acetyl glycolic acid chloride and δ-carbomethoxypentanoyl chloride gave the corresponding 2-acylamino-3-chloro-1,4-naphthoquinone. The remaining chlorine atom is easily replaced by amination in nitrobenzene solution at temperatures of 140-150° to give the corresponding 2-acylamino-3-amino-1,4-naphthoquinone. Formation of the 2-substituted 4,9-naphth (2,3) imidazolediones was accomplished by heating the corresponding 2-acylamino-3-amino-1,4-naphthoquinone in an alcoholic solution containing 12-15% of 2N sodium hydroxide.

II. Synthesis of 5-Substituted-4,9-naphth (2,3) imidazolediones. Amination of 5-nitro-2,3-dichloro-1,4-naphthoquinone gives a mixture of isomers of 5-nitro-(2 or 3)-amino-(2 or 3)-chloro-1,4-naphthoquinone. Acetylation of the crude mixture of isomers yields a mixture of the isomers of 5-nitro-(2 or 3)-acetamido-(2 or 3)-chloro-1,4-naphthoquinone. Amination of this mixture in nitrobenzene at 145-150° yields a mixture of isomers of 5-nitro-(2 or 3)-acetamido-(2 or 3)-amino-1,4-naphthoquinone. The 5-nitro-4,9-naphth (2,3) imidazoledione was prepared by treating a refluxing solution of this mixture of isomers in ethyl orthoformate with concentrated sulfuric acid. Direct nitration of naphthoquinone imidazole also produced the 5-nitro-4,9-naphth (2,3) imidazoledione. Although the latter method gave a compound which melted about 10° lower, both compounds had the same I. R. spectra and thus appear to be identical.

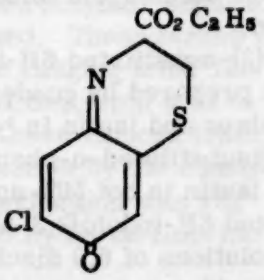
Acetylation of 5-amino-2,3-dichloro-1,4-naphthoquinone produced the 5-acetamido-2,3-dichloro-1,4-naphthoquinone. Amination of this compound followed by acetylation and then amination gave a mixture of isomers of 5-acetamido-(2 or 3)-acetamido-(2 or 3)-amino-1,4-naphthoquinone. Heating this compound in an alcoholic solution containing 12-15% of 2N sodium hydroxide gave crude 5-acetamido-2-methyl-4,9-naphth (2,3) imidazoledione. Heating a solution of the crude product in 20% sulfuric acid gave the pure 5-amino-2-methyl-4,9-naphth (2,3) imidazoledione. Addition of concentrated sulfuric acid to a refluxing solution of 5-acetamido-(2 or 3)-acetamido-(2 or 3)-amino-1,4-naphthoquinone in ethyl orthoformate gave crude 5-acetamido-4,9-naphth (2,3) imidazoledione. Heating this with 20% sulfuric acid gave the pure 5-aminonaphthoquinone imidazole.

III. Synthesis of Some Derivatives of p-Benzoquinone. Methylmercaptobenzoquinone monoguanylhydrazone was prepared by refluxing half a mole of aminoguanidine sulfate and one mole of benzoquinone in ethanol solution containing a few drops of nitric acid. The methylmercaptobenzoquinone monosemicarbazone was prepared similarly. Attempts to prepare the bis-guanylhydrazone of methylmercaptoquinone failed. When excess aminoguanidine sulfate was reacted with one mole of methylmercaptoquinone, the only product which could be isolated was the monoguanylhydrazone.

The reaction of cysteine ethyl ester hydrochloride with methylmercaptobenzoquinone and chlorobenzoquinone gave products whose structure is indicated by I and II respectively.



I

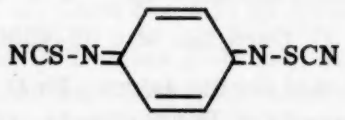


II

Very little work exists in the literature on the reactions of p-benzoquinone bischloroimine. The reaction of this compound in methanol solution with ammonium thiocyanate or potassium thiocyanate resulted in an almost quantitative

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

yield of a compound which has tentatively been assigned structure III.



III. p-benzoquinone bisthiocyanoimine
Microfilm $2.00; Xerox $5.20. 105 pages.

CHEMISTRY, PHYSICAL

ELECTROCHEMICAL POLARIZATION OF HAFNIUM.

(L. C. Card No. Mic 59-4761)

Lewis Battist, Ph.D.
The University of Texas, 1958

Supervisor: Professor Norman Hackerman

Cathodic and anodic polarization of hafnium in neutral NaCl solution and in basic Na_2SO_4 solution was measured at constant current densities. Two systems, air-free and oxygen saturated were studied for both solutions. The direct method was used, and the current density range studied was 0.1 to 10,000 $\mu a/cm^2$. Time-potential curves were obtained and the polarization curves were drawn from the steady state potentials. All cathodic polarization curves were corrected for concentration polarization.

The cathodic polarization curves in the air-free systems were similar, as were the two in oxygenated systems. In the air-free systems the sequence of cathodic reactions was: reduction of dissolved oxygen, hydrogen evolution and hydride formation. In oxygen saturated solutions the sequence was: reduction of dissolved oxygen, formation of a film of unknown composition, hydrogen evolution and hydride formation.

Tafel slopes of 0.12 volts for hydrogen evolution were obtained in both Na_2SO_4 systems and in oxygen saturated NaCl solution. In air-free NaCl solution the Tafel slope was 0.06 volts. The hydrogen overpotential at 1 ma/cm^2 was -0.83 volts in both Na_2SO_4 systems and in oxygenated NaCl. In air-free NaCl it is -0.65 volts.

Hafnium was observed to be severely blistered at high current densities. Dissolution of large amounts of hydrogen into the metal is believed to be the cause.

The air-formed oxide on hafnium is probably present on the surface at all cathodic potentials and anodic potentials attained in this study as shown by capacitance measurements.

Under anodic polarization in NaCl solution hafnium pitted at applied current densities above 5 $\mu a/cm^2$. In Na_2SO_4 solution a protective high resistance oxide film generally formed. In other instances oxygen evolution occurred. The Tafel slope for the oxygen evolution reaction was 0.138 volts, and the overpotential at 1 $\mu a/cm^2$ was 1.54 volts.

The pitting in NaCl solutions is attributed to chloride ion penetration of grain boundaries and surface flaws. When the edge of the metal was masked, pits were randomly distributed over the surface. When not masked, pitting preferentially occurred at the edge of the specimen.

Comparison is made with similar work on titanium and zirconium and a definite trend in electrochemical behavior is evident. Microfilm $2.00; Xerox $6.80. 144 pages.

KINETICS AND MECHANISM OF THE REDUCTION OF Mo(V) BY Sn(II) IN HYDROCHLORIC ACID SOLUTIONS.

(L. C. Card No. Mic 59-4594)

Arpad A. Bergh, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Philip George

The kinetics of the reduction of Mo(V) by Sn(II) has been investigated in 12.0 N and 9.0 N hydrochloric acid solutions at 25 $\pm$ 0.5°C. The rate can be described in both acid concentrations by the rate equation,

$$\text{Rate} = \frac{k_1\,[\text{Mo(V)}]\,[\text{Sn(II)}]}{k_2 + k_3[\text{Mo(V)}] + k_4[\text{Sn(II)}] + k_5[\text{Mo(III)}]} \qquad (3a)$$

and the rate constant ratios were found to be

	in 12.0 N HCl	in 9.0 N HCl
k_2/k_1	0.017	0.028
k_3/k_1	2.4	24.3
k_4/k_1	1.7	2.9
k_5/k_1	0.73	1.82

Investigating the temperature dependence of the rate, an overall activation energy of 10 kcal/mole was found at both acid concentrations. Kinetic analysis has shown this temperature dependence to be due primarily to the reaction step denoted by the rate constant k_1.

In order to get some information concerning the species of the reactants and products, the change in the absorption spectrum of Mo(III) with changing acid concentration, and the kinetics and mechanism of the reduction of Mo(VI) by Sn(II) in 12 N HCl have been studied. It was found that the change in the spectrum of Mo(III) corresponds to a gradual replacement of chlorine by oxygen if the acid concentration is lowered. Increasing the acid concentration brings about the reverse reaction. From the mechanism of the reduction of Mo(VI) by Sn(II) there is a substantial evidence that the reaction

$$\text{Mo(IV)} + \text{Sn(II)} \longrightarrow \ldots\ldots$$

- if it occurs at all - is much slower than the disproportionation of Mo(IV), which rules out the possibility of a chain reaction for the reduction of Mo(V) by Sn(II).

Three mechanisms yielding the derived rate expression have been listed and discussed in detail. The most likely is the following,

1. $\text{Mo(V)} \qquad \text{Mo}^*$
2. $\text{Mo}^* + \text{Mo(V)} \longrightarrow$ deactivation

3. $Mo^{*} + Sn(II) \rightarrow$ products

4. $Mo^{*} + Mo(III) \rightarrow$ deactivation

where Mo^{*} is an active species of Mo(V), probably formed by the loss of O^{-2}, OH^{-} or H_2O from $MoOCl_5^{-2}$, $MoOHCl_5^{-}$ or $Mo(OH_2)Cl_5$ respectively.

Microfilm $2.00; Xerox $5.60. 111 pages.

NUCLEAR ELECTRIC QUADRUPOLE INTERACTIONS IN IONIC SOLIDS.

(L. C. Card No. Mic 59-4490)

Robert Allan Bernheim, Ph.D.
University of Illinois, 1959

The Na^{23} nuclear quadrupole coupling has been measured as a function of pressure and temperature for $NaNO_3$ and as a function of temperature for $NaBrO_3$. From these quantities, and from the compressibilities and thermal expansion coefficients, it is found that the quadrupole coupling varies as $\nu\alpha\ V^{-2.0}$ for $NaBrO_3$ and as $\nu\alpha\ V^{-3.8}$ for $NaNO_3$. These dependencies upon volume together with the previously known volume dependence of $\nu\alpha\ V^{-1.9}$ for $NaClO_3$ are compared with theoretical values computed from point charge models for the crystal lattices. The large volume dependence for $NaNO_3$ arises from anisotropic thermal expansion and compressibility of the hexagonal crystal plus the retention of size and configuration of the NO_3^{-} group. The experimental results for $NaClO_3$ can be explained in the same manner, assuming a rigid ClO_3^{-} group. A rigid BrO_3^{-} group does not account for the volume dependence of the Na^{23} quadrupole coupling in $NaBrO_3$, because the field gradient is very sensitive to the charge distribution in this crystal.

A value of $|Q_9| = 0.112 \times 10^{-24}\ cm^2$ was found for the nuclear quadrupole moment of Be^{9} using a theoretical solid state field gradient and the quadrupole coupling of Be^{9} observed in beryl. The calculations of the field gradient components q_{xx}, q_{yy}, and q_{zz} at the position of Be^{++} and a calculation of the axially symmetric field gradient at the Al^{+++} site in beryl were performed using a point charge model for the crystal lattice. The unique feature of this calculation is that the charge distribution in the crystal is adjusted to fit the experimentally determined asymmetry parameter, η, for Be^{9} in beryl.

The nuclear electric quadrupole interaction of Cu^{63} in Cu_2O is used to measure the internal pressure developed within an adhesive when it is dried or cured. The pure quadrupole resonance frequency is measured for Cu_2O dispersed in a dried resin and compared with the frequency for a sample of pure powdered Cu_2O. The frequency shift together with the previously measured pressure coefficient of the resonance frequency yields an internal pressure of 2300 ± 400 psi for a sample of an epoxy type resin cured at 80°C for 1½ hours.

Microfilm $2.00; Xerox $5.20. 103 pages.

THE ELECTRICAL CONDUCTANCE OF DILUTE SOLUTIONS OF LITHIUM IN METHYLAMINE AT -78.3° C.

(L. C. Card No. Mic 59-4596)

Donald Shelon Berns, Ph.D.
University of Pennsylvania, 1959

Supervisor: E. C. Evers

The conductances of lithium-methylamine solutions at -78.3° were determined over the concentration range from 1.798×10^{-4}N to 2.234×10^{-1}N. The limiting conductance was evaluated graphically by the method of Shedlovsky. This method was also used to obtain an approximate value for an equilibrium constant representing the interaction of the "solvated" electron and metal ion to for an ion-pair. The limiting value of the equivalent conductance and the ion-pair equilibrium constant for the lithium-methylamine system are compared with the corresponding values for the constants in sodium-ammonia systems.

The equilibria suggested by the Becker, and Deigen, models for metal-ammonia solutions were applied to this system.

$$M = M^{+} + e^{-} \qquad k_1 = \frac{[M^{+}][e^{-}]}{[M]}$$

$$M = \tfrac{1}{2}M_2 \qquad k_2 = \frac{[M_2]^{\frac{1}{2}}}{[M]}$$

M^{+} is the metal ion, e^{-} the solvated electron, M is the ion-pair or monomer, and M_2 is the dimer. The mass action constants for the above equilibria are evaluated using the author's conductance data in a conductance function originally suggested by Evers. Calculated values of the equivalent conductance are obtained from the conductance function and the agreement of these values with experimental values is extremely good up to concentration of at least 3×10^{-2}N.

The optical properties of the lithium-methylamine system as reported by Shatz are correlated with the conductance data. The molar extinction coefficients for the solvated electron, monomer and dimer were calculated using the mass action constants derived from conductance data. Calculated values for the optical density of the solutions at the absorption maximum are in fairly good agreement with reported experimental values except in the most dilute region. Evaluation of the optical densities of each of the absorbing species leads to the conclusion that the dimeric species was most probably largely responsible for the absorption maximum. This is in agreement with spectral evidence from other metal-amine and metal-ammonia solutions. Microfilm $2.00; Xerox $5.60. 113 pages.

FACTORS GOVERNING THE SELECTIVITY OF ANION EXCHANGERS.

(L. C. Card No. Mic 59-2949)

Benjamin Thomas P-N Chu, Ph.D.
Cornell University, 1959

The purpose of the present work is to examine the effects of a variety of factors governing resin selectivity. The experimental work is concerned mainly with anion exchange processes on strong base resins, using radioactive tracers.

Measurements are reported of the distribution ratios of tracer bromide, iodide, perrhenate, tungstate, chromate, indium(III), cobalt(II), and zinc(II) on Dowex-1 resin (2%, 4%, 10% or 16% DVB) from various alkali metal and substituted ammonium chloride solutions, as well as from hydrochloric acid (except for tungstate and chromate). Also reported are the perrhenate-chloride exchange as a function of resin composition on Dowex-1 (2% and 10% DVB), the distribution ratios of tracer perrhenate on Dowex-1 (10% DVB) from hydrobromic acid, lithium bromide, nitric acid and lithium nitrate solutions, and the absorption of non-exchange electrolytes from concentrated external solutions (above a few tenths molal).

To account for the origin of resin selectivity, which is a non-thermodynamic problem requiring assumptions as to the nature of the resin phase, a molecular model is considered. The resin phase resembles a concentrated electrolyte solution modified by the hydrocarbon matrix environment. In addition to the immobility of the resin fixed ions, the resin phase differs from the external solution in that the electrostatic forces between ions are stronger and water in the resin phase is less available for hydrating the ions and has a less cooperative structure.

With dilute external solutions, where no non-exchange electrolyte enters the resin phase, the selectivity of the resin for ions may be correlated with the degree of hydration of the ions. As measures for the latter, the crystallographic size and the strength of the acid derived from the anion may be considered; the larger the ion and the stronger the acid, the smaller will be the hydration of the ion, and the greater its selectivity by the resin. This generalization, as well as the increase in selectivity with increasing cross-linkage and decreasing equivalent fraction on the resin, argue for the validity of the treatment of the resin phase as a concentrated electrolyte solution modified by the hydrocarbon matrix.

In the concentrated solution region, non-exchange electrolyte in the resin phase becomes appreciable. Resin selectivity now also depends upon the nature of the macro cation.

$$(\bar{M}) = \frac{-(\bar{R}') + \sqrt{(\bar{R}') + 4\,\frac{\gamma_{MCl}}{\bar{\gamma}_{MCl}}(Cl)^2}}{2}$$

where ( ) represents the concentration, the superscript bar indicates the resin phase and charges have been omitted for simplicity; $(\bar{R}')$ is the concentration of resin sites in meq. per gm. of resin water; γ_i is the stoichiometric activity coefficient of the compound i.

When $4\,\frac{\gamma_{MCl}}{\bar{\gamma}_{MCl}}\,\frac{(Cl)^2}{(\bar{R}')^2} \ll 1$, $(M) \alpha (Cl)^2$; when the inequality is reversed, $(M) \alpha (Cl)$.

Observation of the distribution ratios of tracer Br^-, ReO_4^-, $InCl_4^-$, $CoCl_4^=$, $ZnCl_4^=$ from HCl solutions indicates an anomalous HCl effect. This effect may be correlated with the reaction of a hydrogen ion with an anion to form an ion-pair or a true molecular species in the resin phase rather than in the external solution. The use of a stronger (HBr) and of a weaker (HNO_3) acid as macroelectrolytes show a smaller and a larger difference, respectively, when compared to the corresponding lithium salts.

Microfilm $2.30; Xerox $8.20. 176 pages.

NUCLEAR MAGNETIC RESONANCE STUDIES OF MOLECULAR MOTIONS IN SOLIDS AND SPIN-SPIN COUPLING IN ACETYLENE.

(L. C. Card No. Mic 59-4509)

Thomas Clark Farrar, Ph.D.
University of Illinois, 1959

This thesis consists of two parts, the first of which is concerned with an experimental investigation of the role played by molecular size and shape in determining what motions are possible in molecular crystals; the halomethanes were chosen for this study since their size, shape and symmetry can be easily and systematically varied. The second part is a detailed valence-bond (VB) calculation of the proton spin-spin coupling constant of acetylene; an analysis of the errors in spin-spin coupling calculations is made and a method for obtaining more accurate exchange integrals is given.

Conventional broad line techniques are used to measure the nuclear magnetic resonance (NMR) line width and line shape, as a function of temperature, for the halomethanes. The motions manifest in the solid state depend on the size and shape of the molecules; only the molecules of the sort CH_3X and CHX_3 (X is a halogen) manifest appreciable motion below their melting points. The potential energy barrier to reorientation, V_o, is given by: $V_o \alpha V_r/V_f$, where V_r is the volume swept out by the molecule while in motion and V_f is the volume occupied by the molecule when at rest. The experimental measurements are in good agreement with the results predicted by theory.

A six-electron valence-bond calculation of the ground state wave function of acetylene has been performed. A two-center two-electron Hamiltonian was used to calculate the molecular integrals, which were adjusted to fit the empirical bond energy values. The resulting wave function yields a value of 9.7 cps for the proton-proton coupling constant. Since the experimental value is 9.1 cps, this indicates that the method used is reliable in the extreme case of acetylene, as well as in other hydrocarbons.

Microfilm $2.00; Xerox $5.00. 96 pages.

ADSORPTION OF POLAR ORGANIC COMPOUNDS ON STEEL.

(L. C. Card No. Mic 59-4765)

Howard F. Finley, Ph.D.
The University of Texas, 1958

Supervisor: Professor Norman Hackerman

Adsorption isotherms and relative inhibitor efficiencies were obtained for pyrrolidine, piperdine, hexamethylenimine, heptamethylenimine, 1,4,4 trimethylpiperdine, 1 benzyl piperdine, diallylamine, tetrahydrofuran, tetrahydropyran, and tetrahydrothiophene. With the exception of diallylamine, all exhibited pure chemisorption with no measurable physical absorption. The amount chemisorbed was several times greater than for similar aliphatic compounds and varied as the cross-sectional area of the molecules.

The relative inhibitor efficiency was dependent on the number of methyl groups in the hydrocarbon tail and to the number attached to the polar group. The relative inhibitor efficiency was explained on the basis of the inductive effect of a methyl group and the electron density on the polar group available for coordination with a surface atom. It was postulated that an increase in the number of methyl groups increases the electron density of the polar group and lowers the ionization energy of the molecule. This leads to a stronger binding energy in the charge-transfer-no-bond adsorption complex formed between the adsorbate molecule and the surface. This agrees with the Hackerman-Makrides general adsorption theory of corrosion inhibition by organic compounds.

In studying the pretreatment of the steel it was found that its reaction with 1N H_2SO_4 obeyed the equation

$$\text{Hydrogen volume} = C_0 \ln^2 t + C_1$$

The significance of the constants C_0 and C_1 was discussed, and one possible derivation of the equation given.

Microfilm $2.10; Xerox $7.80. 160 pages.

THERMODYNAMICS OF SOLUTIONS: THE CARBON TETRACHLORIDE-METHYLENE CHLORIDE SYSTEM.

(L. C. Card No. Mic 59-4151)

Albert Joseph Ignatowski, Ph.D.
Purdue University, 1959

Major Professor: Charles R. Mueller

An experimental program has been carried out to determine the solution properties of the non-electrolyte system, carbon tetrachloride-methylene chloride.

The volume changes on mixing for the system were obtained at 20.00°C by means of density measurements. The excess volume was found to be positive with a maximum expansion of 0.335% at 0.455 mole fraction CCl_4.

The liquid-vapor phase diagrams were determined at 30°, 35° and 39°C. For this purpose, an equilibrium still was used which is quite similar to that designed by G. Scatchard. Total pressures were measured by a precision manometer and cathetometer system, while temperatures were measured to ± 0.001°C by means of a platinum resistance thermometer-Mueller temperature bridge arrangement.

From this data, the excess free energies of mixing were obtained. However, the excess entropy and the enthalpy could not be deduced from the temperature derivative of the activity coefficients due to the experimental fluctuations masking their weak temperature dependence.

In view of the immense difficulty of obtaining semblance of true equilibrium with the device used, a factor which has limited the utility of the vapor pressure data of this research, the criteria of equilibrium attainment have been investigated. A method of in situ vapor analysis is indicated.

From the transport properties, one can deduce the parameters of the intermolecular potential for the system. Of the transport properties, the coefficient of gaseous viscosity was chosen as the most reliable and convenient experimentally. The apparatus used for these measurements was similar to that of Maxwell in his study of the kinetic theory of gases. A moveable set of three glass discs are suspended by a torsion wire and move parallel to and between a fixed set. The damping of the oscillatory vibrations in the presence of the vapor is observed optically. The viscosities of the pure components and several mixtures of CCl_4 and CH_2Cl_2 were measured at 20°, 80° and 140°C.

The parameters of the Lennard-Jones potential were easily obtained in the case of the pure materials. On the other hand, mixture analysis proved much more difficult and a stochastic method of curve fitting was used which successfully reproduced the data.

Liquid viscosity measurements were also made on this system at 20°C. From this, the excess free energy of activation for viscous flow was deduced. The result is consistent with the empirical relationship of Eyring between this quantity and the excess free energy of mixing.

A comparison of the experimental results with several theoretical predictions was made. The smoothed well approximation of Prigogine, the modified lattice vacancy theory of Mueller and a dipole interaction theory were considered. Prior to this analysis, the original but cumbersome thermodynamic equations of Stupegia were reduced to an easily applicable form. It was found that the Mueller theory fits the thermodynamic data quite well, while the cell model gave a much better fit of the volume. Despite the evidence that mere dipole effects were operative in this system, the theory based on such effects was found inadequate. Microfilm $2.05; Xerox $7.20. 155 pages.

HEAT CAPACITIES AT HIGH TEMPERATURES.

(L. C. Card No. Mic 59-983)

Charles E. Kaylor, Ph.D.
University of Alabama, 1958

An ice calorimeter was constructed and calibrated.

The enthalpies of steel and platinum containers were determined in the temperature range of 300 to 900° C.

The enthalpies of cesium chloride, cesium iodide, rubidium fluoride and hafnium fluoride were determined in

the range of 300 to 900° C. The following heat content equations were derived from these data: ($H = H_T - H_{273.16}$)

Cesium Chloride:

(α-solid, 300 to 469° C)
$H = 6.6686\ T + 4.3647 \times 10^{-3} T^2 - 7.8989 \times 10^5 T^{-1}$ cal. Mole^{-1}

(β-solid, 469 to 645° C)
$H = 23{,}008 - 51{,}641\ T + 4.0668 \times 10^{-2} T^2$ cal. Mole^{-1}

(liquid, 645° to 900° C)
$H = 19{,}014\ T - 1.1008 \times 10^{-3} T^2 - 1.9066 - 10^6 T^{-1}$ cal. Mole^{-1}

Cesium Iodide:

(solid, 300 to 634° C)
$H = 2.8028\ T + 7.9048 \times 10^{-3} T^2 - 1.4582 \times 10^5 T^{-1}$ cal. Mole^{-1}

(liquid, 634 to 900° C)
$H = 6.3510\ T + 6.6280 \times 10^{-3} T^2 + 3.3804 \times 10^6 T^{-1}$ cal. Mole^{-1}

Rubidium Fluoride:

(solid, 300 to 775° C)
$H = 2.9071\ T + 7.6880 \times 10^{-3} T^2 - 1.6958 \times 10^5 T^{-1}$ cal. Mole^{-1}.

(liquid, 775 to 900° C)
$H = -1464.4 + 17.438\ T$ cal. mole^{-1}

Hafnium Fluoride:

(solid, 300 to 850° C)
$H = 17.293\ T + 6.2023 \times 10^{-3} T^2 - 2.2262 \times 10^6 T^{-1}$ cal. Mole^{-1}

From these data the following heat capacity equations were derived:

Cesium Chloride:

(α-solid, 300 to 469° C)
$C_p = 6.6686 + 8.7294 \times 10^{-3} T + 7.8989 \times 10^5 T^{-2}$ cal. mole^{-1} deg.$^{-1}$

(β-solid, 469 to 645° C)
$C_p = 51.641 + 8.1336 \times 10^{-2} T$ cal. mole^{-1} deg.$^{-1}$

(liquid, 645 to 900° C)
$C_p = 19.014 - 2.2016 \times 10^{-3} T + 1.9066 \times 10^6 T^{-2}$ cal. mole^{-1} deg.$^{-1}$

Cesium Iodide:

(solid, 300 to 634° C)
$C_p = 2.8020 + 1.5810 \times 10^{-2} + 1.4582 \times 10^5 T^{-2}$ cal. mole^{-1} deg.$^{-1}$

(liquid, 634 to 900° C)
$C_p = 6.3510 + 1.3256 \times 10^{-2} T - 3.3804 \times 10^6 T^{-2}$ cal. mole^{-1} deg.$^{-1}$

Rubidium Fluoride:

(solid, 300 to 775° C)
$C_p = 2.9071 + 1.5376 \times 10^{-2} T + 1.6958 \times 10^{-5} T^{-2}$ cal. mole^{-1} deg.$^{-1}$

(liquid, 775 to 900° C)
$C_p = 17.438$ cal. mole^{-1} deg.$^{-1}$

Hafnium Fluoride:

(solid, 300 to 850° C)
$C_p = 17.293 + 1.2405 \times 10^{-2} T + 2.2262 \times 10^6 T^{-2}$ cal. mole^{-1} deg.$^{-1}$

By using the heat capacity data for each compound the changes in entropy in the temperature range 300 to 900° C were determined graphically at 25° C intervals.

Microfilm $2.00; Xerox $5.20. 103 pages.

INHIBITOR EVALUATION FROM CATHODIC POLARIZATION MEASUREMENTS.

(L. C. Card No. Mic 59-4767)

Robert André Legault, Ph.D.
The University of Texas, 1958

Supervisor: Dr. Norman Hackerman

The work of Stern and that of Kaesche and Hackerman showed that corrosion rates on iron and mild steel could be determined by cathodic polarization measurements alone in media of sufficiently low pH. The present study indicates that difficulties are encountered at pH values as low as 2.0. It also shows that in buffered media at pH values as high as 5.0, cathodic polarization measurements will yield satisfactory corrosion rates on iron and mild steel. It was demonstrated that the presence of an oil phase in the amount of 20% of the total fluid used as the test medium does not appreciably affect the determination of corrosion rate.

Kaesche and Hackerman showed that corrosion rates on iron can be determined even in the presence of amine corrosion inhibitors and that the efficiency of these materials as corrosion inhibitors for iron can be determined in an acidic medium (pH 1.0). The present work indicates that relative corrosion rates of iron and steel in systems buffered to a pH of 5.0 can be determined in the presence of an oil phase, carbon dioxide, and commercially used amine inhibitors. The method described provides a rapid and relatively accurate means of evaluating the efficiency of industrial corrosion inhibitors in systems which simulate actual industrial operating conditions.

Microfilm $2.00; Xerox $4.20. 77 pages.

COMPLEXES OF CYCLIC ETHERS WITH BORON TRIFLUORIDE AND OF CYCLIC IMINES WITH TRIMETHYLBORON.

(L. C. Card No. Mic 59-4952)

Donald Eugene McLaughlin, Ph.D.
University of Michigan, 1959

A manometric investigation of the boron trifluoride complexes of some unsubstituted and substituted tetrahydrofurans and tetrahydropyrans and the trimethylboron complexes of N-methyl cyclic imines was undertaken to obtain quantitative thermodynamic data on the effect of ring size and methyl substitution upon the stability of the addition compounds formed.

An improved apparatus for manometric measurements was devised which utilized the vapor of a boiling liquid for constant temperature control. A manostat permitted automatic regulation of the pressure on the boiling liquid at any preset value. The advantages of the apparatus were the close temperature control maintained without drift, the speed with which the temperature could be changed from one value to another, and the convenience of its operation.

Enthalpy (kcal./mole), free energy (cal./mole), and entropy (e.u.) data for the gas phase dissociation of the addition compounds of boron trifluoride with the various ethers are as follows:

dimethyl ether ($\Delta H^0 = 13.65$, $\Delta F^0_{100} = 1308$, $\Delta S^0 = 33.1$)

diethyl ether ($\Delta H^0 = 11.93$, $\Delta F^0_{100} = 665$, $\Delta S^0 = 30.2$)

tetrahydrofuran ($\Delta H^0 = 16.80$, $\Delta F^0_{100} = 3145$, $\Delta S^0 = 36.5$)

2-methyltetrahydrofuran ($\Delta H^0 = 17.83$, $\Delta F^0_{100} = 2763$, $\Delta S^0 = 40.4$)

2,5-dimethyltetrahydrofuran ($\Delta H^0 = 19.80$, $\Delta F^0_{100} = 2879$, $\Delta S^0 = 45.3$)

tetrahydropyran ($\Delta H^0 = 15.42$, $\Delta F^0_{100} = 2510$, $\Delta S^0 = 34.6$)

2-methyltetrahydropyran ($\Delta H^0 = 9.78$, $\Delta F^0_{100} = 818$, $\Delta S^0 = 24.0$)

2,6-dimethyltetrahydropyran ($\Delta H^0 = 11.9$, $\Delta F^0_{100} = -87$, $\Delta S^0 = 32.2$)

For the addition compounds of trimethylboron with N-methyl cyclic imines, the data are as follows:

N-methylethylenimine ($\Delta H^0 = 18.52$, $\Delta F^0_{100} = 2601$, $\Delta S^0 = 42.7$)

N-methyltrimethylenimine ($\Delta H^0 = 17.61$, $\Delta F^0_{100} = 2606$, $\Delta S^0 = 40.2$)

N-methylpyrrolidine ($\Delta H^0 = 10.67$, $\Delta F^0_{100} = 752$, $\Delta S^0 = 26.6$)

N-methylpiperidine ($\Delta H^0 = 7.05$, $\Delta F^0_{100} = 568$, $\Delta S^0 = 17.4$)

The results for tetrahydrofuran and tetrahydropyran are consistent with the interpretation that the change in angular requirements in the two ring sizes results in a redistribution of electrons in the molecule and, hence, affects the availability of the lone pair electrons of the oxygen. The data on alpha methyl substituted ethers show both inductive and steric effects, the latter being more pronounced in the 6-membered ring.

The stability order obtained for the trimethylboron addition compounds of the N-methyl cyclic imines was 3->4->5->6-membered ring, which is different from that which had been reported for the unsubstituted cyclic imines, namely, 4->5->6->3-membered ring. The complete reversal of the relative position of the 3-membered ring is due to the large steric interaction caused by the N-methyl group, which becomes more pronounced as the ring size increases. Microfilm $2.00; Xerox $5.80. 116 pages.

PHASE EQUILIBRIA IN THE SYSTEM CaO-FeO-Fe_2O_3-SiO_2.

(L. C. Card No. Mic 59-5121)

Bert Phillips, Ph.D.
The Pennsylvania State University, 1959

Several studies of parts of the system CaO-FeO-Fe_2O_3-SiO_2 have been reported in the literature but a thorough knowledge of the system has not been attained. The present investigation was undertaken to aid in establishing the phase relations among these oxides. Because iron exists in both the ferrous and the ferric states, the partial pressure of oxygen must be controlled if all compositions are to be included in the study.

The quenching technique was used to make three separate but related studies. Liquidus relations were determined for the system in air ($p_{O_2} = 0.21$ atm.). The results obtained under these isobaric conditions are expressed by projection onto the CaO-Fe_2O_3-SiO_2 composition plane. The position of the isobaric surface relative to the quaternary system is indicated by projecting onto the same plane points representing compositions having equal Fe^{2+}/Fe^{3+} ratios in the liquids at liquidus temperatures. New terms are introduced for describing isobaric equilibria expressed in projections.

Phase equilibria at liquidus temperatures in the system Fe_3O_4-Fe_2O_3-$2CaO{\cdot}Fe_2O_3$ were also determined. In this part of the investigation, samples were maintained in closed systems during equilibration. In addition, methods for obtaining equilibrium data at oxygen pressures greater than one atmosphere have been developed, and new data concerning the system Fe_3O_4-Fe_2O_3 were obtained.

Phase equilibria at liquidus temperatures in the system CaO-iron oxide-SiO_2 in air are presented. Nine isobaric invariant situations have been located, and the position of the isobaric surface relative to the quaternary system is indicated. Paths of equilibrium crystallization for selected mixtures were used to obtain a phase diagram for the join $CaO{\cdot}SiO_2$-$2CaO{\cdot}Fe_2O_3$. In conjunction with data available in the literature, the data obtained in this study are used to present two isothermal sections illustrating phase relations at subsolidus temperatures; one is applicable in the temperature interval 1192-1155°C, the other below 1155°C.

Equilibrium data regarding the system Fe_3O_4-Fe_2O_3 obtained by maintaining iron oxide samples in sealed containers have permitted drawing of a more complete phase diagram for this system. The eutectic temperature has been established at 1563 ± 2°C. The oxygen pressure of the gas phase in equilibrium with magnetite, hematite, and liquid at this temperature is estimated to be $10^{1.2}$

atmospheres. The limit of solubility of Fe_2O_3 in Fe_3O_4 was found to be about 40 wt.%.

In determining the phase relations at liquidus temperatures in the system Fe_3O_4-Fe_2O_3-$2CaO{\cdot}Fe_2O_3$, seven invariant points were located in the temperature interval 1190-1230°C. Isothermal sections at several temperatures within this range have been drawn. Oxygen pressures necessary for equilibrium at liquidus temperatures are suggested on the basis of those already determined experimentally and those reported for liquidus and subsolidus temperatures in the system Fe-O. X-ray powder data are presented for two ternary phases encountered in this study. Paths of equilibrium crystallization were followed to obtain a phase diagram for the system Fe_3O_4-$CaO{\cdot}Fe_2O_3$.

Microfilm $2.00; Xerox $5.60. 114 pages.

HYDROGEN SORPTION ON GRAPHITE AT ELEVATED TEMPERATURES.

(L. C. Card No. Mic 59-5123)

John P. Redmond, Ph.D.
The Pennsylvania State University, 1959

Heating graphite in a vacuum resulted in a rapid evolution of gas which quickly decreased to a very slow rate. Hydrogen was found to be a major constituent of this released gas. The purpose of this thesis was to investigate the manner by which hydrogen was sorbed on graphite.

The kinetics for the hydrogen desorption were applied to various chemisorption and diffusion theories and were found to fit the Roginsky-Zeldovich equation. This chemisorption theory was valid when there was a linear distribution of active sites on the surface.

The desorption kinetic isotherms were measured for nuclear graphite over a temperature range from 900° to 1500°C. The desorption activation energies for hydrogen were evaluated and found to vary linearly with surface coverage which agreed with the theory. The values ranged from approximately 160 kcal./mole to 60 kcal./mole from zero to full coverage respectively.

It was found that hydrogen and carbon monoxide were adsorbed on graphite which previously had been degassed at high temperatures, but helium was not taken up. This chemisorbed hydrogen also obeyed the Roginsky-Zeldovich equation on desorption.

Adsorption isotherms were measured over this same temperature range. The data were found to fit the Temkin equation over the middle range of surface coverage. This equation was based on a linear variation of the heats of adsorption with coverage, and thus, it was identical to the Roginsky-Zeldovich theory. The slopes of the adsorption isotherm plots were found to increase with temperature as prescribed by the Temkin equation, and the heats of adsorption calculated by the Clausius-Clapeyron equation were found to vary linearly with surface coverage. The desorption of hydrogen from spectroscopic graphite was investigated and the results were in agreement with those obtained from nuclear graphite.

A brief survey of the outgassing characteristics (that is the amount and the analysis of the evolved gases) was made on the following types of graphite; nuclear, spectroscopic, and electrode. It was found that hydrogen and carbon monoxide were the major constituents of the gas released from these graphites and carbon dioxide, water vapor, and hydrocarbons were present in smaller percentages. There was a possibility that nitrogen was present in small percentages, but it was not established with certainty.

A corelation between gas release and the ash content of these graphites was found, and it was calculated that the released gas could be accommodated on the edge atoms of the graphite crystallites.

Microfilm $2.05; Xerox $7.20. 153 pages.

THE DETERMINATION OF DIFFUSION-INDUCED CONCENTRATION GRADIENTS IN POLYMER FILMS.

(L. C. Card No. Mic 59-5297)

David Richman, Ph.D.
Cornell University, 1959

A microradiographic technique has been developed for measuring the concentration gradients of liquids which are diffusing into polymer films. The procedure involves the diffusion of a species of high x-ray absorptivity into a polymer film in order to establish a concentration gradient. The gradient is then fixed by chilling the film. The chilled film is microtomed to obtain a slice of known thickness, which is mounted on a fine grain photographic plate. The assembly is positioned in a beam of parallel x-rays, so that their traverse through the slice is in a direction perpendicular to the diffusion direction. After exposure and developing, the resultant image is scanned with a microdensitometer of high resolving power.

The procedure has been applied to the gradients which result from the diffusion of methyl iodide into polyvinyl acetate at a temperature above that for the glass transition. The method shows explicitly that the assumption of an equilibrium concentration at the surface of the polymer is valid. It also leads to diffusion coefficients which agree satisfactorily with those obtained by measurements of the rate of sorption of the methyl iodide vapor.

Conventional weight gain experiments have been made for the sorption of methyl iodide vapor into films of polyvinyl acetate at 20°C. and also into films of cellulose acetate at 40°C. Both systems exhibit the characteristic "anomalous" behavior which normally accompanies diffusion of organic vapors into glassy polymers. The concentration gradients which result from this diffusion have been measured for these systems using the microradiographic procedure. The observed gradients are different from those found for diffusion in non-glassy polymers. In particular the surface concentrations attain their equilibrium values only very slowly, varying with time according to the equation

$$C_s = C_o + (C_{eq}-C_o)(1 - e^{-\beta t}).$$

The initial surface concentration C_o is commonly only a small fraction of the final value C_{eq}. If one now assumes this dependence of surface concentration on the time and also utilizes a constant value for the diffusion coefficient, it is possible to obtain explicit solutions for Fick's Law for diffusion both into an initially dry polymer and into a polymer pre equilibrated with a given amount of vapor. The

resulting equations can explain the anomalous behavior found for the former case and the two-state behavior found for the latter. Microfilm $2.00; Xerox $4.60. 86 pages.

INDUCED INFRARED ABSORPTION IN MIXED GASES AT HIGH PRESSURE

(L. C. Card No. Mic 59-3784)

Robert William Rinehart, Ph.D.
University of Minnesota, 1959

The intensities of simultaneous transitions were studied in the systems CF_4-H_2, SiF_4-H_2, CO_2-H_2, CF_4-N_2, CO_2-N_2, and CO_2-CH_4. The enhancement of the pressure-induced H_2 fundamental by CO_2, CF_4, SiF_4, and H_2 was also considered.

Methods and apparatus were described for loading two gases into a cell at high pressures (10 to 100 atm.) and precisely known concentrations. The concentrations were determined by a weighing technique and this technique was described in detail.

Straight infrared intensities on two fundamental bands of CF_4 were studied. Pressures used for this work were low (0.2 mm Hg to 13 mm Hg) and the methods and apparatus used were described.

Details were given for the construction and use of a long-path-length cell.

Experimental measurements of the absorption coefficients were reported for all of the absorption bands studied. Microfilm $2.40; Xerox $8.40. 184 pages.

ELECTRODE REACTION KINETICS IN FUSED POTASSIUM CHLORIDE-LITHIUM CHLORIDE.

(L. C. Card No. Mic 59-4560)

David Kelmer Roe, Ph.D.
University of Illinois, 1959

The kinetic parameters of four electrode couples in fused KCl-LiCl eutectic at 450°C have been experimentally measured using the voltage step method, as developed by Vielstich and Delahay. A theoretical discussion of electrode kinetics is given along with the modifications from which the kinetic parameters are calculated by this method. Differences between the theoretical and experimental current-time curves, during the initial period of kinetic control ($<2 \times 10^{-5}$ sec.) are discussed with respect to the validity of the theoretical assumptions. A method of correcting for such differences was devised. The corrections proved to be significant for the slower electrode reactions which were investigated.

Considerable attention has been given to preparation and purification of the eutectic melt. The method adopted involved displacement of heavy metal ion impurities by metallic magnesium and filtration of the molten eutectic through sintered quartz. A tenfold decrease of impurities was realized by this procedure. Other experimental techniques are given, such as the preparation of microelectrodes with liquid metal surfaces and platinum microelectrodes with a small roughness factor.

The experimental results show that some charge transfer reactions are very rapid, as might be expected in fused salts, but the rate of the bismuth couple was surprisingly slow. The kinetic parameters of molar exchange current density, transfer coefficient and heterogeneous rate constant for each electrode couple are respectively: Cd(II)/Cd(lq), 210 amps. $cm.^{-2}$, 0.13, 0.4 $cm. sec.^{-1}$; Zn(II)/Zn(lq), 150 amps. $cm.^{-2}$, 0.10, 0.4 $cm. sec.^{-1}$; Bi(III)/Bi(lq), 8 amps. $cm.^{-2}$, 0.48, 9×10^{-4} $cm. sec.^{-1}$; and V(III)/V(II), 30 amps. $cm.^{-2}$, 0.67, 0.3 $cm. sec.^{-1}$.

The equipment used in the kinetic studies was also used to measure the differential double layer capacity of a platinum surface in contact with the melt. The variation of double layer capacity with potential indicates that chloride ions are specifically adsorbed over a span of about 0.6 volts. Microfilm $2.00; Xerox $4.00. 73 pages.

TOTAL COLLISION CROSS-SECTIONS FOR THE INTERACTION OF MOLECULAR BEAMS WITH GASES.

(L. C. Card No. Mic 59-4980)

Erhard William Rothe, Ph.D.
University of Michigan, 1959

Total collision cross-sections for the interactions of molecular beams of K, Cs and CsCl with a number of gaseous molecules have been measured using the mean free method. A narrow beam (0.003 cm wide) was passed through a chamber containing the scattering gas. The resolution of the apparatus was 30 seconds of arc. The attenuation of the beam was measured as a function of the scattering gas pressure. From these data the mean free paths and scattering cross-sections Q were calculated.

Measurements of Q were found to be reproducible to about ±10%. However, it was found that the ratio of the cross-sections of two gases with a given beam molecule could be measured with a probable error of ±3%. Thus all results have been reported as the ratio (Q^*) of the cross-section for a given molecule to the cross-section of argon for the same beam molecule: Q^* = Q(beam molecule-gas)/Q(beam molecule-argon).

Eighty molecules were studied with K beams, 16 with Cs and 17 with CsCl beams. The scattering molecules were varied in size, molecular weight, complexity and chemical reactivity (e.g. He, O_2, $SnCl_4$, $(CH_3)_2CO$ and $C_8H_{17}Br$). Values of Q^* ranged from 0.29-2.8 for K and Cs; from 0.37 to 4.4 for CsCl.

Massey and Mohr have carried out a quantum theoretical analysis of the elastic scattering and evaluated the cross-section for the case of gaseous atoms subject to an attractive potential $V(r) = -C/r^6$, where C is a constant for a given pair of atoms and r is the distance between the particles. Their expression for the total cross-section is $Q = k(C/v)^{2/5}$ where v is the relative velocity of the colliding particles and k is a known constant. C may thus be calculated from the observed values of Q.

C may also be estimated from existing theoretical formulas. To obtain the intermolecular potential, it was necessary to consider contributions from direct dipole-dipole,

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

dipole-induced dipole and London dispersion forces. Only refraction data and a knowledge of the molecular dipole moments were necessary for these estimates of C and thus Q and Q^*.

The measured cross-sections have been compared with those calculated from theory. Although the theoretical values are not in close accord with the experimentally determined absolute cross-sections Q, values of the relative cross-section Q^* are predicted with good accuracy. Of the 96 molecules studied with K and Cs beams, calculated values of Q^* agreed with those observed within the experimental error (±3%) for 57% of the molecules; for 87% of the molecules the agreement was within ±10%. Most of the large deviations were found to occur with the light gases.

It has been found that the results of two previous investigations could be reasonably well correlated by the theory.

The present experiments have demonstrated the separate effects of the dispersion, dipole-induced dipole and direct dipole-dipole intermolecular forces.

Microfilm $2.00; Xerox $5.60. 115 pages.

THE INTERNAL FRICTION OF SIMPLE ALKALI SILICATE GLASSES CONTAINING ALKALINE EARTH OXIDES.

(L. C. Card No. Mic 59-5126)

Robert John Ryder, Ph.D.
The Pennsylvania State University, 1959

Simple alkali silicate glasses exhibit two peaks in the internal friction curve between -50° and 500°C when the internal friction is measured at frequencies of the order of 1 cps. These peaks appear in the range -40° to -30°C and 100° to 200°C. The low and high temperature relaxations have been attributed to stress induced alkali ion movement and nonbridging oxygen ion movement respectively. The purpose of this investigation was to study the effect of alkaline earth oxides on these relaxation processes. The addition of alkaline earth oxides to simple alkali silicate glasses has a strong influence on the durability of these glasses which is explained on the basis of a tying up of the alkali and nonbridging oxygen ions. For this reason, it was expected that this tying up of the alkali and nonbridging oxygen ions by the alkaline earth cation would cause major changes in the internal friction peaks attributed to the movement of these ions.

The internal friction of fibers 6 inches long and 0.8 mm. in diameter was measured at a frequency of 0.4 cps. as a function of temperature by measuring the decay of torsional vibrations of a system in which the fiber acted as the elastic number. The compositions studied can be represented by the following formula:

$$R_2O \cdot XR'O \cdot (3-X/2)SiO_2$$

where

R = Li, Na and K
R' = Mg, Ca and Ba
X = 0, 0.05, 0.10, 0.25 and 0.50

Substitution in the above fashion kept the number of alkali and oxygen ions constant.

The addition of the alkaline earth oxides to the alkali silicates glasses produced three important changes:

1. The two peaks were shifted to higher temperatures.
2. The two peaks decreased in height above background.
3. In over half of the series studied, a new and strong peak appeared at higher temperatures in the range 250° to 350°C which increased in height and shifted to lower temperatures with increasing alkaline earth oxide content.

The shift of the peaks to higher temperatures was shown to be due to an increase in the activation energy for the relaxation process causing the peak. The decrease in peak height above background, which was not accompanied by an appreciable broadening of the peak, was explained by a decrease in the concentration of the relaxing mechanisms and reflected the tying up of the nonbridging oxygen and alkali ions by the alkaline earth cation. An interaction between alkaline earth-rich clusters and the network was suggested to explain the new high temperature peak.

The behavior of the high temperature peak with increasing alkaline earth oxide content was opposite to that observed for the other two peaks. In order to investigate this new peak more thoroughly, several alkali-free alkaline earth silicate and phosphate glasses were studied. Despite the absence of alkali ions in the glasses, a low temperature peak was found. It was pointed out that if this peak in the alkali-free glasses cannot be explained by a stress induced movement of the divalent cations similar to that described for the alkali ions, it may be necessary to reevaluate many of the current ideas concerning the nature of the low temperature peak. Other results in the alkali-free glasses indicated that the appearance of two peaks in the high temperature region can be associated with the presence of two network modifying cations in the glass structure.

Microfilm $2.40; Xerox $8.40. 183 pages.

SUBSOLIDUS STUDIES IN THE SYSTEM $NaAlSiO_4$-$NaAlSi_3O_8$-H_2O.

(L. C. Card No. Mic 59-5127)

Prasenjit Saha, Ph.D.
The Pennsylvania State University, 1959

Subsolidus studies were carried out in the system $NaAlSiO_4$-$NaAlSi_3O_8$-H_2O in an effort to determine the phase equilibria relations of minerals and compounds occurring in this system, and to apply the knowledge gained thereby to the interpretation of the genesis of minerals and rock types confined to this range of composition. Hydrothermal runs were made in the range 200°-700°C and 5,000-45,000 psi, with charges sealed in gold capsules in cold-seal pressure vessels. The products were examined by standard optical and x-ray diffraction methods.

The following minerals were synthesized and their stability investigated: nepheline solid solution, albite, analcite solid solution, nepheline hydrate I and paragonite. The compound zeolite "B" was also synthesized. The minerals natrolite and jadeite, and the compounds nepheline

hydrate II and zeolite "A" did not appear in the hydrothermal runs. Natrolite was found to be unstable at 300°C and 30,000 psi in the presence of excess water vapor.

Experimental investigations and theoretical calculations indicated that the alkali-rich portion of the system does not remain ternary at low temperatures under the conditions of the experiments, and this can be explained by the loss of soda, alumina and silica in the vapor phase.

The following transitions, within the P-T-X region involved, were studied in detail:

(1) nepheline hydrate I + water = nepheline + water

(2) analcite solid solution + water = nepheline solid solution + albite + water

(3) analcite solid solution (composition - $NaAlSi_3O_8 \cdot 1.5H_2O$) + water = albite + water

Analcite was found to exhibit solid solution through an extensive range of composition, but field and laboratory evidence suggests that part of it may be metastable. The range of solid solution found in nature is more restricted than the range determined experimentally, but it was demonstrated that the nature of the solid solution is essentially the same. From the crystal chemical point of view, the nature of the solid solution is at variance with the currently accepted model of the structure of analcite.

Petrogenetic implications of the investigation have been discussed. Preferential solubility of soda and alumina in the vapor in runs made with glasses whose compositions lie in the alkali-rich portion of the system, indicates a possible mode of nephelinization of country rocks surrounding bodies of alkaline rocks. The transition analcite solid solution (composition - $NaAlSi_3O_8 \cdot 1.5H_2O$) + water = albite + water would be important geochemically if it could be shown that the reaction is reversible. Attempts to demonstrate this reversibility were unsuccessful, and it was concluded that perhaps analcite solid solution of albite composition appears metastably.

Deeply buried slightly metamorphosed sedimentary rocks, composed almost exclusively of pyroclastic material, show abundant development of minerals of the "zeolite" facies. The nature of the parent material and the nature of the metamorphism suggest that equilibrium was never attained, and that the "zeolite" facies cannot be classified with the other facies of regional metamorphism. Experimental work carried out on the formation of the assemblages analcite solid solution + nepheline solid solution and analcite solid solution + albite would, perhaps, be useful in ascertaining the temperature and pressure of development of the "zeolite" facies.

Microfilm $2.00; Xerox $7.20 151 pages.

THE GRAFTING OF VINYL PYRROLYDONE ON DEXTRAN.

(L. C. Card No. Mic 59-3636)

Kwei-ping Shen, Ph.D.
Polytechnic Institute of Brooklyn, 1959

Adviser: Frederick R. Eirich

A new graft copolymer of polyvinylpyrrolidone on dextran was prepared in view of the possibility that it might combine the advantageous properties of both homopolymers. The work reported here, however, does not stress the clinical properties of the graft copolymer, but rather the fundamental aspects of preparation, separation, and physical properties of the graft copolymer.

Several methods of preparation were applied. Each method gave a different type and efficiency of grafting. Graft copolymers were prepared by (1) chain transfer reactions of dextran with vinyl-pyrrolidone chain radicals initiated by azo-bis-isobutyronitrile, (2) high energy radiation, (3) far ultraviolet light in the presence of photosensitizers. Coupling of the two homopolymers, e.g., dextran and polyvinylpyrrolidone, by chemical methods had also been attempted.

A procedure for isolating the graft copolymer from its two free homopolymers had been worked out on the basis of their different solubilities. The isolated graft copolymer was proved by turbidity titration to be a true compound and not a mixture of two homopolymers. The compositions of the graft copolymers were also determined by nitrogen analysis and hydrolysis. As regards the latter, the stability of polyvinylpyrrolidone toward mild acid and the ready acid hydrolysis of dextran to glucose suggested a convenient way to determine the grafted chain length of polyvinylpyrrolidone. The average degree of polymerization of the polyvinylpyrrolidone homopolymer was found to be 1.3 times that of the grafted polyvinylpyrrolidone chains on dextran.

The chain transfer activity of dextran with vinyl-pyrrolidone radicals was studied and the transfer constant determined to be 5.9×10^{-4} at 50°C. During the kinetic study, the rate of polymerization of vinyl-pyrrolidone in aqueous medium was noticed to be affected by the pH of the medium. The reason for the change in the rate of polymerization of vinyl-pyrrolidone with pH is not clear. Possible suggestion is that the rate of decomposition of azo-bis-isobutyronitrile in aqueous media may be dependent on pH, or that the polarity of the monomer and the chain radical may be affected.

Interaction properties of the graft copolymers with amino acids were found to be the same as that of polyvinylpyrrolidone. Microfilm $2.00; Xerox $5.20. 101 pages.

KINETICS OF COMPETITIVE, CONSECUTIVE REACTIONS WITH APPLICATION TO REACTIONS OF LITHIUM ALUMINUM HYDRIDE AND METHYLMAGNESIUM BROMIDE WITH 1-HEXYNE.

(L. C. Card No. Mic 59-4468)

George B. Smith, Ph.D.
University of Pittsburgh, 1959

The theory of competitive, consecutive reactions was studied, and a general test for consistency of experimental data with kinetics of this type was found. The single-path reaction, indicated below, was given special attention.

$$A_0 + X \xrightarrow{k_1} A_1 + P'$$

$$A_1 + X \xrightarrow{k_2} A_2 + P''$$

$$\vdots$$

$$A_{n-1} + X \xrightarrow{k_n} A_n + P^{(n)}$$

For the two-step and four-step reactions, numerical calculations were carried out, and graphs were obtained. These graphs provide a method for finding what information about the relative values of the rate constants is available from experimental data consisting of the concentration of the species X as a function of time and the initial concentration of the species A_0.

Lithium aluminum hydride and 1-hexyne in ethyl ether were found to react according to the following stoichiometry:

$$LiAlH_4 + 4\ H\text{-}C{\equiv}C\text{-}C_4H_9 \rightarrow LiAl(C{\equiv}C\text{-}C_4H_9)_4 + 4\ H_2$$

This system remained homogeneous, and it was possible to control the temperature to within $\pm$ 0.1° C. during reaction. Application of the theory to data for the rate of hydrogen evolution showed that there is some deviation from the four-step reaction. It is postulated that this deviation may be caused by the existence of polymeric hydride species. Catalysts for the reaction of lithium aluminum hydride with 1-hexyne in ethyl ether were produced by reaction of lithium aluminum hydride with ammonia, primary and secondary amines, pyridine, and tertiary amine N-oxides. The catalyzed reaction is zero-order in hexyne, and the rate of reaction is determined by the ratio of the initial concentration of catalyst to the initial concentration of hydride. The rate of the catalyzed reaction is greatly decreased in the presence of small quantities of methylmagnesium bromide. It is postulated that the catalytic activity is caused by the metallic amide, either by coordination of the amide group with the lithium aluminum hydride, making the hydride more reactive, or by acting as a proton-transferring agent.

The reaction of lithium aluminum hydride with ethyl bromide in ethyl ether is believed to proceed as follows:

$$AlH_4^- + C_2H_5Br \xrightarrow{k_1} AlH_3 + C_2H_6 + Br^-$$

$$AlH_3 + C_2H_5Br \xrightarrow{k_2} AlH_2Br + C_2H_6$$

This reaction system was found to become heterogeneous, even in the presence of triethylamine, and the kinetic data for ethane evolved indicate that k_1 is much larger than k_2. Neither triethylamine nor a catalyst for the reaction of lithium aluminum hydride with 1-hexyne had any effect on the rate of the ethyl bromide reaction.

Data for the reaction of methylmagnesium bromide with 1-hexyne in ethyl ether were obtained with temperature controlled to within $\pm$ 0.1° C. during reaction. These data were treated in terms of ideal models which were based upon the theory of competitive, consecutive reactions and upon the assumption that the reaction is primarily

$$(CH_3)_2Mg{\cdot}MgBr_2 \rightleftharpoons (CH_3)_2Mg + MgBr_2$$

$$(CH_3)_2Mg{\cdot}MgBr_2 + H\text{-}C{\equiv}C\text{-}C_4H_9 \rightarrow (CH_3)(C_4H_9\text{-}C{\equiv}C)\text{-}Mg{\cdot}MgBr_2 + CH_4$$

$$(CH_3)_2Mg + H\text{-}C{\equiv}C\text{-}C_4H_9 \rightarrow (CH_3)(C_4H_9\text{-}C{\equiv}C)Mg + CH_4$$

etc.

Application of the theory to data for methane evolved shows that the mechanism involves second-order steps, i.e., first-order in the Grignard species and first-order in hexyne. None of the models used agree completely with the experimental data. However, this is not surprising, since each model was based on some oversimplifying assumptions concerning the molecular constitution of the Grignard reagent.

Microfilm $2.00; Xerox $5.40. 106 pages.

THE ANODIC PASSIVATION OF IRON.

(L. C. Card No. Mic 59-4770)

Earl Samuel Snavely, Jr., Ph.D.
The University of Texas, 1958

Supervisor: Dr. Norman Hackerman

A study of the anodic passivation of iron was made in solutions of 0.1 M sodium sulfate at a pH of 3.0. A mass balance of iron equivalent to coulombs required for passivation and iron determined in solution by the o-phenanthroline method after passivation revealed that a maximum of 0.002 coulombs is involved in the passive layer. A discussion of alternate electrode processes and their effect on the results is presented. Heating the iron electrode in air prior to passivation or addition of chelating agents to the electrolyte has an adverse effect on passivation producing characteristic arrests in the charging curve. A Flade arrest does not appear in decay traces of anodic potential unless a potential of at least 1.2 volts (E_H) is achieved on charging the electrode indicating incomplete coverage by the passive layer below 1.2 volts. Partial cathodic reduction and anodic reformation of the passive layer at the Flade arrest showed that the initial current involved in reformation is 100% efficient when as much as 70% of the Flade arrest is reduced. These results support the view that only a fraction of the passive layer is represented by coulombs involved in the Flade arrest and that after partial reduction the remainder of the passive layer disintegrates spontaneously. Microfilm $2.00; Xerox $5.40. 106 pages.

EFFECTS OF X-RAYS AND ULTRAVIOLET LIGHT ON TOBACCO MOSAIC VIRUS.

(L. C. Card No. Mic 59-4474)

David Trkula, Ph.D.
University of Pittsburgh, 1959

The purpose of this investigation was to establish whether or not the rod-shaped particles of tobacco mosaic virus nucleoprotein (TMV) or its ribose nucleic acid (RNA) were broken by X-rays and ultraviolet light. It was also a test of the proposition that the radiosensitive target of TMV might be its RNA.

In the X-ray experiments, a D_o dose of 2.3×10^5 roentgens was calculated from inactivation results obtained prior to this investigation. TMV solutions were irradiated with up to 8 D_o doses of X-rays. Portions of the irradiated solutions and corresponding control solutions were subjected to viscosity, sedimentation, and electron image analyses in order to determine whether or not particle size distributions of irradiated TMV were different from those of the controls. RNA was liberated from the remaining portions of irradiated and control TMV by heat denaturation of the protein. RNA solutions were then purified and their intrinsic viscosities evaluated.

For the ultraviolet light studies, an inactivation experiment was performed, and the D_o dose was evaluated. TMV was irradiated with ultraviolet light at doses of up to 91 times the D_o dose. Intrinsic viscosities were evaluated for irradiated TMV and for corresponding control solutions. RNA was obtained from other portions of irradiated and control TMV solutions by heat denaturation of the protein. It was then purified, and intrinsic viscosities were evaluated.

Results of viscosity, sedimentation, and electron image analyses were very nearly the same for TMV which had been irradiated with 8 D_o doses of X-rays and for control TMV. The intrinsic viscosity of RNA from TMV irradiated with 8 D_o doses of X-rays was found to be about 50 per cent less than the intrinsic viscosity of RNA isolated from control TMV.

A D_o dose of 6.3×10^9 erg/gm was calculated from the ultraviolet light inactivation results. The values of intrinsic viscosity determined for TMV which had received up to 91 D_o doses of ultraviolet light were approximately the same as those obtained for corresponding control TMV. However, the intrinsic viscosity of a solution of RNA separated from TMV which had received 71 D_o doses of ultra violet light was about one-half that of a solution of RNA prepared from control TMV.

The results obtained in both the X-ray and ultraviolet light experiments were interpreted as indicating that particles of TMV were not broken by the two radiations at the large doses employed. The intrinsic viscosity results obtained for RNA isolated from x-irradiated and ultraviolet light irradiated TMV were interpreted in terms of depolymerization of the nucleic acid. The results in the X-ray experiments are considered to be consistent with the proposition that the radiosensitive target of TMV might be its nucleic acid. It is proposed that a difference might exist between the mechanisms of inactivation of TMV by X-rays and by ultraviolet light. Microfilm $2.00; Xerox $4.60. 87 pages.

ECONOMICS, GENERAL

TRANSITION TO MULTIPLE-LINE INSURANCE COMPANIES: LEGAL PROCEDURES AND IMPACT ON FINANCIAL STRUCTURES

(L. C. Card No. Mic 59-4597)

David Lynn Bickelhaupt, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Clyde M. Kahler

The transition to multiple-line insurance companies is perhaps the most significant change of the present decade in property and casualty insurance. Prior to this, insurance companies in the United States often were limited in their transactions to one major kind, or "line," of insurance. Now the opposite characteristic prevades the industry, with most insurance carriers writing widely-diversified types of protection against the uncertainties of property and liability loss.

It is logical and important that this new broadened scope of insurance company operations should be closely analyzed. The tendency toward this type of product diversification in insurance has, and shall continue to have for many years, far-reaching results. Many of the effects are impossible to analyze at this time, either for lack of statistical data or because the transition is so incomplete that observations of the changes are misleading. Thus, this study excludes the related but separate trends: analysis of multiple-line contracts; the newer "all-lines" (including life insurance) trend; multiple-line company groups; and the widespread effects of multiple-line insurance on the companies' major functions of underwriting, rating, sales, claims, investment and management.

The study of the heritage and background of multiple-line insurance ideas provides the basis for research in this area. Following this, the problem of this dissertation centers upon the legal procedures which have made multiple-line insurance companies possible, and the changes in their financial structures during the transition period.

The method of this study is first to investigate how and when the present multiple-line laws of the States emerged. The objectives and legal requirements, both general and financial, are analyzed in order to determine the pattern and scope of the laws of the States in granting multiple-line authority. Techniques of changing to multiple-line insurers are studied to see how such companies evolved. The final section concerns the changes in financial structure during the transition to multiple-line insurance companies. Thirty-five leading multiple-line companies are chosen for detailed analysis of the changes in their major balance sheet items. Similar statistical research is pursued in order to obtain an industry group of primarily non-multiple-line companies, and the results in the two sections are compared.

Multiple-line insurance has been thus far subjected to very little rational study. This dissertation is recognized as but a segment of the extensive study needed in this field. A foundation, however, is provided by this work for future investigations in other multiple-line insurance topics. The first accomplishment is the identification of the major trends in the development of the multiple-line ideas and laws, establishing a comprehensive understanding of today's broad insurers of both property and casualty perils. Second, examination of the reasons for formation of multiple-line companies points out that many professed specific objectives may be resolved into a few basic goals. Similarly, tracing the transition to multiple-line insurers shows that the techniques of changing to broader operations center largely on several basic legal and financial adjustments and procedures by mono-line insurance carriers.

Finally, the scope and difficulties involved in analysis of the impact of multiple-line companies are emphasized by statistics developed on the changes in financial structure. Wide disparity is exhibited in individual company changes, while as a group the multiple-line companies showed greater improvement than the industry as a whole, as measured by major accounting and financial indices. However, the dangers of imputing all these changes to multiple-line operations are underscored in the conclusions of this study. The significance of the transition to multiple-line insurance companies lies in its indirect, widespread and uncompleted impact. Thus continued research in this area will be imperative and beneficial.

Microfilm $4.25; Xerox $14.40. 331 pages.

THE EFFECT OF LAYING FLOCK SIZE ON THE ECONOMICS OF EGG PRODUCTION IN NORTHEASTERN INDIANA

(L. C. Card No. Mic 59-4138)

Ludwig Maria Eisgruber, Ph.D.
Purdue University, 1959

Major Professor: Earl W. Kehrberg

Indiana farmers sell approximately 105 million dozens of eggs every year. The question arises, whether the same quantity of eggs could be produced more cheaply if farmers had larger flocks, and by how much the cost of production could be lowered. It was the primary objective of this study to shed light on this question by determining possible economies of size in the laying flock enterprise and the extent of these economies. Further an attempt was made to determine production guides and standards and to test various techniques as to their usefulness in making empirical cost studies.

The empirical information upon which this study is based was obtained from laying flock owners in Northeastern Indiana. All laying flock owners were members of a selected market.

The cooperating laying flock owners kept detailed

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

enterprise records on their flocks for one year. A comparison of management practices and other factors related to the laying flock enterprises of record keepers with those of other flock owners in the selected market did not indicate a significant difference.

Average cost curves were estimated for three models, depicting three different cost conditions: One, where operating expenses, labor and capital are cost components, a second one where labor and operating costs are considered, and a third one where only operating expenses are considered as cost. The vector-regression method was used for deriving unit cost curves in all three models.

The best fitting long-run cost function for the growing flock enterprise in model I has the form of a parabola, indicating diseconomies of size for flock sizes larger than about 800 pullets. Empirical evidence to support these diseconomies of size is weak, however. The long-run cost curve for egg production is a hyperbola, indicating rather pronounced economies possible if output is extended beyond low levels, and almost constant unit costs for increasing flock size beyond about 800 birds.

The shape of the long-run cost curves for the growing flock and the laying flock as estimated in model II are the same as those in model I. But since capital cost is not considered as a cost component in model II, the cost curves of this model indicate lower costs than do those of model I.

No relationship was found between unit cost and quantity of output in model III.

The total revenue function for the poultrymen in the selected market is linear, i.e., marginal revenue is constant. Given constant marginal revenue and cost curves as estimated in models I and II, the most profitable enterprise is an indefinitely large one. However, a dynamic analysis of the problem of the most profitable size of enterprise indicates that profits are overestimated by a static analysis.

A comparison of the hyperbolic cost function obtained by the conventional regression estimate and the hyperbolic cost curve estimated by the vector-regression method shows that both curves differ only with respect to their location. The relative slope and shape of the two curves are not significantly different.

A cost curve estimated by the vector-regression method will always be located below the conventional regression estimate. The slope of the two cost curves will be the same if homoscedasticity of variance exists, if the degree of skewness is the same at all levels of output, and if the lower limits of cost can be estimated. A long-run cost curve estimated by the vector-regression method tends to be biased in favor of diseconomies of size at high levels of output if the observations taken at high levels of output do not approach the lower limits of cost to the same degree as the observations taken at low levels of output.

Average figures of cost and returns for laying flocks were computed. Based on these figures residual estimates of average returns to labor and management per hour were $1.15 for the period of record keeping.

Existing economies of size, although only slight beyond a flock size of about 800 birds, will encourage the establishment of large laying flocks. But since small producers ordinarily face relatively smaller out-of-pocket costs than large producers, the latter will not likely be in a position to "squeeze" out the small producer very rapidly.

Microfilm $2.20; Xerox $7.80. 166 pages.

A CASE STUDY OF THE INDIANA RESTAURANT ASSOCIATION

(L. C. Card No. Mic 59-4140)

Howard Coleman Giles, Ph.D.
Purdue University, 1959

Major Professor: Paul L. Farris

The primary objectives of this study were to determine the programs and the activities of the Indiana Restaurant Association, to evaluate the relationship between the association and the members, to determine how association activities may improve the members and the industry, and to obtain information on business problems and on the physical operation of firms in the restaurant industry, both IRA member firms and nonmember firms.

The Indiana Restaurant Association was chosen for the study because it is an active and a successful association and it represented an industry composed of many firms; yet membership in the IRA was a small portion of the total industry. The procedure followed was to analyze the historical files of the association to determine its development, and to sample members and nonmembers to determine their attitudes toward the association and their evaluation of the association, the business problems the firms faced and differences if any between members and nonmembers. A stratified random sample was used. To further evaluate the IRA a limited number of associate members were also interviewed.

The IRA was founded in 1933 primarily as a result of the depression and NRA. From this founding the association developed a variety of programs to aid and assist members in the operation of their business. By 1956-57 the primary programs were (1) educational activities (2) legislative activities, (3) publication of trade news and information (4) an industry trade show (5) legal aid (6) business promotion and (7) membership activities. Programs developed primarily through the initiative of the executive officer and board of directors and in response to membership needs.

The IRA as a functioning organization appears to have oligarchical characteristics. This is not deemed detrimental to the IRA, because it enables quick action by the association and because many members do not take an active part in the association. The association also evidences cooptation in leadership selection. Effects of cooptation upon operation are undetermined. Logically, however, this may enhance operation of the association as an economic firm.

Members and nonmembers were significantly different from each other in measures of size of business. Members had significantly larger gross and net income, seating capacity, number of people served a day, and size of dining area than did nonmembers. There was no significant difference between member and nonmember as to location, type of establishment and hours devoted to business between the two groups.

Further conclusions of the study indicate that the actions of a trade association improves the knowledge of members, facilitates communication, and increases the efficiency of the industry. An industry composed of many firms is, through an active trade association, so organized that the industry can receive legislative benefits that would not be

possible without organization. Association activity aids in determining policy decision by channeling the views of its members to the governmental body.

Microfilm $3.60; Xerox $12.20. 280 pages.

AN ECONOMIC PROJECTION OF THE DOMESTIC PETROLEUM INDUSTRY

(L. C. Card No. Mic 59-4453)

Fred T. Haner, Ph.D.
University of Pittsburgh, 1959

Adviser: R. F. Blackburn

The objective of analyzing the petroleum industry through 1970 was to determine the availability of net income for the drilling activity necessary to maintain domestic reserves. Current trends indicate that it will be inadvisable for a profit motivated company to drill for a large portion of American oil resources.

The cost of replacing oil is beginning to exceed the going price for a barrel of crude. One cause for this trend is the size of fields currently being discovered. In 1938, 51 per cent of successful exploratory wells found new fields of more than one million barrels. In 1952 this figure was 19 per cent. The decline from a 1947-1949 average of 27 barrels of reserves added per foot drilled to 11.5 in 1957 is also causing serious concern within the petroleum industry. The projection of the barrels added to reserves per foot drilled ratio showed: (1) a downward trend toward the lower limits of return on drilling investment; and (2) the effect of past drilling which has discovered our readily available reserves and explains the declining trends.

The cost of exploration and development on a per foot drilled basis reached a level of $14.25 in 1957, 90 per cent higher than the pre-World War II average. To project this variable into the future, a multiple correlation approach resulted in a sharp rise to $24.40 per foot by the year 1970.

A survey of 20 major oil companies revealed: (1) these companies are drilling deeper wells; and (2) their costs per foot have increased only 30 per cent since 1947, as compared to 39 per cent for the industry. When the drilling efficiencies of the major oil companies are weighted, future costs per foot are less than the direct multiple correlation solution.

	1960	1965	1970
Costs per Foot Drilled	$16.50	$19.50	$22.00

A company's income will reflect the price of crude oil and control the volume of exploration and development. The average price per barrel in the years 1946 to 1949 was $2.10. It was $3.01 in 1958. The results of a correlation with domestic demand, exports, and the wholesale price index showed the future price of crude at $3.30 in 1960, and increasing to $4.40 in 1970. Revenue received from natural gas on a per barrel basis has increased from an average of $.16 in the period 1946-1949 to $.46 in 1957.

An Index of Financial Drilling Incentive was compiled to analyze exploration and development activity as it is affected by this price-replacement cost relationship. This index declines from 104 in 1960 (1957 = 100) to 0 in 1970 illustrating the disproportionate increase in the cost of replacing each barrel produced to meet current needs.

To provide a framework for analyzing the effect of changing sources of supply, forecasts for domestic demand, imports, and exports have been estimated.

A multiple correlation solution for domestic consumption using gross national product in constant dollars, population, and privately owned vehicles in operation obtained a correlation of .99 out of 1 over 30 years of historical data. The forecast showed a gain of 55 per cent to 5.190 billion barrels in 1970. A projection of exports revealed a gradual decline throughout the period to a level of 60 million barrels a year from the 1958 figure of 105 million barrels. To project imports the series was correlated with cost per foot of well and the percentage of total completions classified as wildcats. The results showed an increase of 105 per cent over twelve years to 1.240 billion barrels in 1970 if controls are ignored. Production is then determined as follows:

	Billion Barrels		
	1960	1965	1970
Demand	+3.580	+4.350	+5.190
Exports	+ .115	+ .090	+ .060
Imports	- .750	-1.020	-1.240
Production	2.945	3.420	4.010

Drilling activity can be related to domestic production through the barrels produced per foot drilled ratio. Confirmed by the Index of Financial Drilling Incentive, the projected barrels produced per foot drilled ratio yields a decline from a 1960 level of 225 million feet to 131.7 million feet. Reserves during the forecast period will suffer from the decline in drilling and the diminishing size of new fields, reaching only 13.2 billion barrels of liquid hydrocarbons, or 3 years supply.

This pessimistic prediction of availability calls for judicious decisions by the Federal Government on the volume of imports to be permitted. To preserve American petroleum resources imports should be increased, but this would be accomplished at the expense of concerns operating wholly in the United States. Prime consideration must be given the consuming public with decisions recognizing that, regardless of the tact taken, a portion of the oil industry will suffer financial losses.

Microfilm $2.00; Xerox $5.00. 96 pages.

FEDERAL POLICY ON SECONDARY BOYCOTTS IN LABOR DISPUTES

(L. C. Card No. Mic 59-4454)

Fred V. Hartenstein, Ph.D.
University of Pittsburgh, 1959

Adviser: R. E. Slesinger

While the Labor Management Relations Act of 1947 deals with secondary boycotts in labor disputes, section 8(b)(4) of the Act merely establishes the framework around which present federal policy is built.

In order to be able to evaluate critically that policy the following procedure was followed: (1) The evolution of federal policy was traced from the common law conspiracy and restraint of trade doctrines, through the Norris-LaGuardia

Act, to the Taft-Hartley Act. (2) The background of the present policy was examined through an analysis of (a) the provision of the Act; (b) the Congressional hearings and debates preceding passage of the Act. (3) The status of secondary boycotts under Taft-Hartley was examined through an analysis of the interpretative NLRB and court doctrines. (4) Recommendations for changes and criticisms of the provision were analyzed and evaluated. (5) Finally recommendations were presented to cope with some of the inconsistencies of present federal policy on secondary boycotts.

The writer found that present policy on secondary boycotts can only partially be explained by the Taft-Hartley boycott provisions. The present policy is to a large part the outgrowth of interpretative doctrines developed by the NLRB and the courts whose interpretation of the statute has at times failed to be consistent with the provisions of the Act and with previous Board and court interpretations.

The fluctuating Board and court decisions, doctrines, and dicta can be attributed to the Board's and the judiciary's lack of success in interpreting Congressional intent. That in turn is due to the underlying confusion, lack of clarity of thought, and lack of understanding betrayed by the proponents of boycott proscriptions during the Congressional hearings and debates. The detailed examination of these debates shows a continuing confusion as to the nature, the purposes, and the effects of secondary boycotts.

When Congress tackled the secondary boycott issue for a second time during the 1953-1954 hearings on revision of the Taft-Hartley Act, numerous shortcomings of the 1947 legislation were brought out, and in the final section of the thesis these shortcomings and recommendations both for clarification of the present provisions, as well as a new approach to the boycott controversy are discussed.

Throughout the study one basic assumption was adhered to: namely, that free collective bargaining as espoused in the Norris-LaGuardia Act, section 7 of the NIRA, the Wagner Act, and the Taft-Hartley Act, is and should remain the underlying and fundamental basis of overall federal labor policy. Microfilm $2.85; Xerox $9.80. 218 pages.

AN INVESTIGATION OF THE ECONOMICS OF SOVIET LOCATIONAL DOCTRINE, POLICY, AND PRACTICE—WITH SPECIAL EMPHASIS ON HEAVY INDUSTRY

(L. C. Card No. Mic 59-3054)

John Stanley Hoyt, Jr., Ph.D.
The American University, 1959

This study undertakes an investigation of the economics of Soviet industrial location as related to doctrine, policy, and practice and its correlation with the concepts of Western locational theory.

Chapter I considers the general nature of locational economics and the problems of a locational analysis of the Soviet economy. The ideological doctrines of the Soviet state and their manifestations as specific economic doctrines are examined in the light of their relationship to industrial location decision-making.

Chapter II presents a synthesis of Western locational theory, treating the contributions of Western economists and establishing the framework within which the comparison with Soviet doctrine is effected. The common economic factor found in Western contributions, that of "least cost" considerations, is discussed in its relationship to Soviet locational economics. Chapter III is an analysis of the historical background leading up to current locational doctrine. Present doctrine calls for the observance of five locational principles: (1) Uniform distribution of industry throughout the country, (2) Proximity of industry close to sources of raw materials and consuming areas, (3) Development of underdeveloped regions, (4) Complex regional development, and (5) The strengthening of the defense potential. Each of these principles is examined in the light of its economic and other implications and their interrelationships.

Chapter IV develops the background of the natural locational factors in the USSR. Using this background the pattern of overall industrial location as it has developed over time is considered; this overall pattern is then subdivided with a brief analysis of the regional industrial development of the USSR. Chapter V presents a series of industrial location case studies in which the correlation of doctrine, policy, and practice with the five principles is undertaken. The analysis shows that only the economic principle of "proximity to sources of raw materials and consuming areas" shows any correlation of significance in the ferrous metallurgy sector. The extent to which the other four principles have been implemented is subordinate to, and a result of, the implementation of this economic principle. The analysis of the machine building industry results in the same conclusion. In the analysis of the transportation sector of the economy a direct conflict with the principles of industrial location is found. The early concern of the USSR with rapid industrialization and economics of scale reinforced a policy of intensive railroad development and resulted in a constraint upon locational shift which negated, in part, the implementation of locational doctrine. The investigation of the electric power sector shows a direct correlation with both economic and non-economic aspects of Soviet doctrines. Again, it is evident that the correlation with these non-economic principles is subordinate to the correlation with the economic principle. The final study, that of the fuel industry, provides little direct evidence of either correlation or conflict with the principles enumerated.

The study concludes that, of the five principles of locational doctrine espoused by the Soviet economist, only one, that of "proximity of industry . . ." is an economic principle. Soviet industrial location policy and practice has, in general, conformed to this economic doctrine, which is analogous to Western "least cost" theory. The correlation of policies and practices with one or more of the other principles is a subordinate relationship to this economic principle of least cost. With the exception of the distortion caused by rapid industrialization policies, reinforced by transport policy, the analysis shows that the industrial locational decisions made by the Soviet planner have been made upon much the same economic considerations as they would have been made by his Western counterpart, the entrepreneur.

Microfilm $2.30; Xerox $8.20. 176 pages.

THE PRICING STRUCTURE FOR SOYBEANS AT COUNTRY ELEVATORS AND PROCESSORS IN INDIANA

(L. C. Card No. Mic 59-4154)

Monte Everett Juillerat, Ph.D.
Purdue University, 1959

Major Professor: Paul L. Farris

As soybeans have come to play an increasingly important role in the cropping programs of Indiana farmers, so has interest increased among farmers and country elevator operators in the complex process of buying, grading, and selling soybeans. This process is especially difficult during the harvest season when the soybean movement is heavy.

There are many variations in the soybean market causing differences in returns to farmers and elevator operators. The major objective of this study was to seek out these variations, their magnitudes, their causes if possible, and to make suggestions for reducing the variations found.

The sample was composed of the four Indiana processors and the country elevators located in three Indiana Counties. The counties selected were Grant, Jasper, and Hancock Counties. Soybeans are an important crop in these counties, the competitive structures differ, shipment patterns differ, freight rates differ, and the firms bidding each county differ somewhat.

Daily forms were kept by the elevator operators during the harvest season. Recordings were made of daily paying prices, all bidders and their bids, soybean purchases and storage, and all sales at the price sold and the destination as well as the mode of transportation used.

Separate schedules were completed in an interview with each of the elevator managers and processors. The data collected were related to competitive practices, volumes of business, services, dividends, transportation costs, and buying and selling practices.

The country elevators tended to sell to the same firms throughout most of the harvest season. Bids, however, varied considerably among elevators within any one county. This variation was often two cents or more per bushel. As a result nearly all elevators included in the study could have increased their weighted average selling price for soybeans by from .5 to one cent per bushel.

The farmers also faced price variations. The amount of variation depended upon the county considered, but the variation was often two cents or more on any one day in all three counties. In Grant County there was a tendency for competing elevators to pay different prices at least 67 percent of the time. This tendency was not as strong in Hancock County and even less prominent among the major handlers of soybeans in Jasper County.

Sampling and grading information was collected by going to each of the processors and most of the elevators during the harvest season. Grading determinations were recorded for 20 loads as they arrived at each location. Only soybeans arriving by truck were considered at the processing plants, because the processor has no control over the grading of rail shipments. Either the same sample as used for this determination or a portion of this sample as divided by a divider was taken to the Purdue University Agronomy Department laboratory for grading. In addition, Purdue representatives took an additional sample from each of the loads entering country elevators. These samples were also taken to the laboratory for grading.

Foreign material was the only factor of major importance in grading during the 1957 Indiana soybean harvest season. Wide variations were occasionally found between elevator determinations and those made in the laboratory. The variations reached as high as 8.88 percent difference for one load with the elevators being more lenient in most cases than the laboratory determination indicated. Nearly all of the variation was in loads containing more than one percent foreign material. No factors were found to explain variations in grading among elevators.

There was variation in grading among the processors also. The determinations made by the processors also tended to be lenient.

The farmer in general encountered more price variation among elevators than grading variation. For individual situations this was not always true for farmers delivering soybeans with a high foreign material content. One elevator graded very leniently making the grading differential much more valuable to the farmer than commonly occurring price variations, while several other elevators tended to discount these loads more severely than laboratory determinations indicated. Dividend variations were from none to six cents per bushel, and were paid only by cooperatives.

Although elevator operators did not seek out numerous bidders for their soybeans, these bidders did exist and could have been contacted by phone. Farmers could also use a phone to determine price variations within their market.

The information is therefore available to improve the movement of soybeans from the farm to the areas of highest demand. The improvement of the market rests upon making those involved aware of the magnitudes and frequency of the variations found and the possible gains through more careful buying and selling.

Microfilm $2.00; Xerox $7.00. 147 pages.

ECONOMIC EFFECTS OF FIELD RENTING ON RESOURCE USE ON CENTRAL INDIANA FARMS

(L. C. Card No. Mic 59-4156)

Myron Plough Kelsey, Ph.D.
Purdue University, 1959

Major Professor: Julian N. Atkinson

One of the ways farm operators have responded to the pressures for farm enlargement has been through the increased use of field-rented tracts. Little data have been available from which to draw inferences on the economic effects of this practice. The objectives of the study were to determine: (1) what differences exist between the operation of owned tracts and field-rented tracts of the same farm unit; (2) what differences exist between the operation of field-rented tracts and full-rented farm units; and (3) what provisions of leases cause operators to farm field-rented tracts in a manner different from the owned tracts or full-rented farms.

A stratified random sample of part owners and full renters was selected from county Agricultural Stabilization and Conservation Committee records in five central Indiana counties. Part-owner farms were classified into 25 groups based on the number of acres owned and rented. The

full-renter farms were classified into 7 groups based on the number of acres operated.

Personal interview records were obtained during the summer and fall of 1957 concerning the cropping and livestock program of the farm unit, the leasing provisions of the rented tracts and landlord and tenant characteristics.

The hypotheses were tested by comparing the resource imputs and outputs on the owned and rented tracts of the part-owner firm and field-rented tracts and full-rented farms. Several analyses of variance and other tests of comparison were employed to determine if the amount of land owned or rented or several other factors had any relation to the inputs and outputs of the rented tracts.

The following hypotheses were tested:

(1) Farm practices and production on the field-rented tracts of the part-owned farm unit differ from farm practices and production on the owned tracts. Fewer livestock were maintained on the rented tracts, and a larger proportion of the land was put to corn and soybeans. A smaller proportion of the rented tracts was put in grass and lower rates of application of fertilizer were used on corn and wheat. The yield of corn was lower on the rented tracts and the completion of some field cropping operations was found to be secondary to those on the owned tracts.

(2) Farm practices and production on part-owner field-rented tracts differ from practices and production on full-rented farms. The animal units per acre, proportion of land in grass, application of manure, rate of application of fertilizer on wheat and oats and the yields of wheat and oats were all lower on the field-rented tracts. The proportion of land in corn and application of nitrogen to corn were greater on the field-rented tracts.

(3) When a high proportion of the land resource in a part-owner farm firm is owned, the use of resources on the rented tract is different than when a low proportion of the land resource is owned. The only significant relation detected indicated that as the acreage of owned land in the farm firm increased, the animal units per acre on the rented tracts declined.

(4) Some of the ways in which resources are used on field-rented tracts are due to specific provisions in leases regarding the sharing of costs and income. From the data available this hypothesis could not be substantiated. It appeared that the major differences in the use of resources under presently used leasing arrangements arise from tenure oriented factors and not lease oriented factors.

Microfilm $2.20; Xerox $7.60. 165 pages.

BARGAINING FOR HEALTH: UNION EXPERIENCE WITH HEALTH INSURANCE AND MEDICAL CARE IN THE UNITED STATES

(L. C. Card No. Mic 59-3274)

Raymond Munts, Ph.D.
The University of Wisconsin, 1959

Supervisor: Edwin E. Witte

This study is intended to contribute to the evaluation of voluntary health insurance, to describe the new dimension that prepaid medical care plans have given to collective bargaining, and to support a concept on which future planning can be based.

The method is historical-analytical, using labor sources wherever possible. The author has been a participant-observer of health bargaining from the union side since 1949.

The study is in three sections: Part I is historical; Part II contains one chapter each on the experience of the Ladies' Garment Workers' Union, the United Mine Workers, the Auto Workers, the Steel-workers, and the Amalgamated Clothing Workers; Part III shows how health prepayment has carried collective bargaining from negotiating with employers to "community bargaining" with insurance companies, hospital prepayment plans, doctors, and medical service plans. A chapter on union-sponsored medical service plans concludes Part III.

There are three major findings: 1. The very origins of the labor movement were due as much to the desire for mutual insurance as to the desire to establish trade unions. Labor has sought to grow by alternately emphasizing its welfare and its trade functions. So central is health security to the goals of unionism, that labor cannot stop short of fully-prepaid, high quality medical care. From labor's point of view, the only test of voluntary health insurance is its success in these terms.

2. There is a growing conviction in labor that cash indemnity prepayment inflates the cost and warps the quality of medical care, and that consequently the goal of full prepayment is receding. The organizational separation of prepayment financing through commercial insurance from the provisions of services by medical institutions is at the heart of the problem. Major medical insurance may accelerate the inflation in costs. Solutions are being sought through cost and quality surveillance, and through direct service plans in which prepayment is combined with group practice. However, medical society opposition and forces within labor itself threaten to divert these efforts with ill-conceived diagnostic clinics.

3. Applying controls and encouraging direct service plans draws labor deeper into the complexities of community health bargaining. Dealing effectively with medical societies, for example, is a new and unfamiliar experience for most labor leaders who are not trained to weigh this kind of strategy. Formulation of community health bargaining principles is needed both to shape labor health planning into a community-wide scope and to define for new purposes the pragmatic idealism which is the best food for labor's institutional life.

As a conclusion, it is suggested that such principles derive from the nature and use of "countervailing power" in the medical services market. This power serves moral ends when labor and management use the mass buying of negotiated prepayment plans for reform in medical economics. Both because controls are necessary to save voluntary health insurance, and because medical monopolies opposing these controls can be overcome only through the application of countervailing power, public policy too has a role to play. Microfilm $5.65; Xerox $19.80. 441 pages.

SOCIO-ECONOMIC FACTORS AFFECTING LABOR MOBILITY IN AN INDIANA RURAL COMMUNITY

(L. C. Card No. Mic 59-4169)

Philip Gilbert Olson, Ph.D.
Purdue University, 1959

Major Professor: J. K. McDermott

The growth of the U.S. economy, particularly within the last fifty years, has led to large-scale and complex adjustments. One of these adjustments has been the decline in relative importance of agriculture and the accompanying flow of labor resources out of agriculture. This flow of labor resources which, according to some, is not occurring at a rapid enough rate, has stimulated interest in the problem of labor mobility and migration. The fundamental objective of this study is to lay out a conceptual framework of labor mobility and migration, and to test its adequacy from empirical data collected in a rural farming community in central Indiana. The approach used in this study is cross-disciplinary. Theory and concepts are drawn from both sociology and economics.

The conceptual framework distinguishes job mobility from geographical mobility (migration), and sets up a framework of forces which act to prompt mobility on the one hand (these forces are termed motives of economic and social betterment) and to restrict mobility on the other hand (these forces are termed impediments). The rate of mobility is the net result of these two forces. In addition, characteristics of mobile persons are linked theoretically to both the motives and impediments. These theoretical relationships help to explain the selectivity of mobility which has been noted in previous studies.

Through mail survey techniques, the mobility patterns of one entire farming community were established. From this information a stratified, random sample was drawn and 132 heads of households interviewed.

The job mobile person was found to be younger, have a lower income, and have a lower social status than the non job mobile person. In addition, motives of social and economic betterment were found to exist among the job mobile population; and youth, low income, and low social status found, empirically, to be associated with these motives. Impediments to job mobility, in the form of capital and job skills, were found to limit the extent of job mobility which occurred among the Brookston population. A special examination of a sample of the former farm operators in the Brookston community supported the conceptual framework and hypotheses. The former farm operator was younger, had a lower social status, and a lower economic status than the non mobile farm operator. He also had fewer impediments to job mobility, i.e. the farm unit was smaller, land was rented, and sales were smaller. Additional analysis of this group revealed two types of persons who had quit farming: the voluntary and involuntary job mobile persons. The voluntary job mobile population were younger, more educated, had higher social status, and higher managerial ability scores than the involuntary population. Whereas the voluntary job mobile persons was motivated by desire for economic betterment, the involuntary job mobile person was motivated by status maintenance and economic betterment. The conflicting motives of the latter resulted in an involuntary type of mobility.

The geographically mobile person (migrant) was found to be younger, more educated, and have an average income and social status, compared with the nonmigrant. Motives of social betterment were identified among the migrant population and these related to social status. Impediments to migration, in the form of community attachments, were found to affect the rate of migration. However, the inconclusiveness of some of the data led to the hypothesis that migration may be linked in certain instances to job mobility.

The examination of characteristics of the population divided into job mobile, migrant, and job mobile-migrant categories helped to refine the conceptual framework. The differences between the three mobility types with regard to age, education, income, social status, and occupation led to the conclusions that the migrant was primarily motivated by desire for social betterment, the job mobile person was primarily motivated by the desire for economic betterment, and the job mobile-migrant was motivated by both desires, although it is difficult to say which motivation may have been the dominant one and which incidental. It was also found that the largest proportion of involuntary job mobility occurred among the job mobile population, and the largest proportion of voluntary job mobility occurred among the job mobile-migrant population.

Microfilm $2.00; Xerox $6.80. 143 pages.

LABOR UTILIZATION IN INDEPENDENT INDIANA SUPERMARKETS

(L. C. Card No. Mic 59-4170)

Leland E. Ott, Ph.D.
Purdue University, 1959

Major Professor: C. E. French

Low profit margins and high asset turnover accentuate the need for efficient utilization of resources in the retail food industry. Other than product cost, labor is the largest individual cost or expense item for the retail food firm. Also, it is the only major expense generally subject to control in the short run.

The purposes of this investigation were to describe, analyze, and develop better labor utilization practices for these firms. Though the innovating firm will accrue the initial benefits in the short run, these benefits will be passed on to the general public when improved labor practices are universally adopted in the long run.

This investigation was unique in that emphasis was placed on the reduction of labor expense through management techniques rather than the technical factors influencing labor productivity. Also, the relationships among inter-departmental variables were studied.

Four independent food stores, ranging in weekly sales from $17,000 to $29,000, were selected on the basis of factors, hypothesized to be major determinants affecting labor expense. A ratio-delay time study was conducted for one week in each store to collect labor-input data. This was a pioneering venture in that the previous uses of the ratio-delay technique had been confined to operations under machine-controlled conditions.

Output data in sales, pounds, and cases were collected to measure the efficiency of activities performed. Sales and order-size data were collected on an hourly basis in

order to reflect variations in work requirements throughout the week. Wage-rate data were collected on salaried, full-time, and part-time labor and used to compute labor cost on a departmental basis.

A preliminary report based on part of the findings was extended to the cooperating stores. Action taken on the report represented expected changes under field conditions; thus, the changes made gave a good indication of the importance of using the management approach of this study.

Excellent descriptions of time use were provided by the ratio-delay study. The descriptive material served to orient management to the big problems by focusing attention on major work activities and areas of delay time.

Since the hourly wage rate of the individual worker was determined by labor market conditions and other exogenous factors, the opportunity for wage-rate savings was limited to substituting low-paid labor for high-paid labor.

Labor productivity was affected by many factors in addition to technical considerations of layout, work methods, and equipment. Extreme difficulties of labor scheduling in the checkout department accounted for high delay time (22.4 percent). Problems in management supervision were responsible for excessive delay time (25.8 percent) in the grocery department. However, delay time in the meat and produce departments was only about 13.0 percent.

Order size affected productivity in the checkout department. Checking time requirements decreased, carryout requirements increased, and bagging requirements remained constant as order size increased. Hourly crew size and composition by type of worker were budgeted as guides for better checkout scheduling.

Labor productivity in the meat and produce departments was affected by the relative amounts of various commodities sold. Data from secondary sources were budgeted in order to determine the relative time differences among these different commodities.

Grocery labor productivity was affected by the amount of display space, inventory level, and sales per linear foot of display. When display was large, inventory low, and sales per linear foot of display low, working time was reduced.

Labor requirements and standards for each department were budgeted for each department. These standards were refined to reflect differences in the major factors influencing labor use.

Recommendations from the findings of this investigation were organized into a basic system for reducing store labor costs. This recommended system was designed to reduce labor expense and improve labor scheduling.

The management of the cooperating stores was able to make an average increase of 11.7 percent in labor productivity. All stores were able to use the findings of this study effectively. These results indicated the need to consider the broad aspects of labor utilization problems.

Microfilm $3.45; Xerox $11.80. 266 pages.

ECONOMICS, AGRICULTURAL

PRICING LIVE BROILERS IN NORTHWEST ARKANSAS

(L. C. Card No. Mic 59-4690)

Hilliard Jackson, Ph.D.
North Carolina State College, 1959

Supervisor: Richard Adams King

The objective of this study was to analyze broiler pricing on a daily basis in Northwest Arkansas and to evaluate existing and alternative pricing methods. This required: (1) an analysis of the behavior of local broiler prices and related factors, including (a) national supply and demand forces, (b) structure and competitive nature of the local market, and (c) process of price formation in the area; and (2) an appraisal of existing and alternative pricing practices.

Live broiler prices in Northwest Arkansas were quite variable but not greatly more so than in other areas. The average daily price change was about 1/4 cent per pound, although on some days the price changed as much as one cent per pound. As would be expected, price changes were found to be serially correlated. Price movements as long as three days were likely to continue in the same direction until a price phase of 12 to 15 days was completed. Existence of price phases and cycles indicated the inability of the market to adjust perfectly to changing market conditions; changes in primary supply and consumer demand levels appeared to be more gradual and less erratic.

Since Arkansas is a part of the national broiler market, local prices would be expected to follow nation-wide movements. Analysis of daily prices shows that 77 per cent of Arkansas price variations are associated with variations in Georgia prices (representing the national market). Half of the "unexplained" variation (between-area price spred) is associated with relative volume of marketings in the two areas. Other price deviations between Arkansas and Georgia were attributed to the structure of the local market and system of pricing used, with the opinions and policies of individual dealers being important price making factors.

The structure of the Northwest Arkansas live broiler market has gradually changed from many to few buyers and sellers. The next important structural change appears to be the combination of feed dealers with processors, with processors having more control over supply of broilers. Vertical integration in a sub-market, such as Northwest Arkansas, could give a firm some control over supply, distribution and price regionally, while its monopoly power in the nation-wide market is negligible. Although the local market has some features of imperfect competition it is a part of a national market that is essentially competitive.

The quotation system of pricing broilers, and the prevalence of base price trading, may contribute to price variations in the market. It reduces the time and cost of price negotiation for members of the trade but results in a major problem of small volume of trading on the open market.

The most important need is for adequate and accurate supply, demand and price information. Consideration should be given to fractional cent trading and to buying and selling broilers on the basis of accepted grades. These changes would permit the supply and demand forces to be brought into sharper focus in the local market and contribute to more orderly marketing and pricing of broilers.

The present system of pricing broilers in Northwest Arkansas is about as old as the industry itself. In spite of the imperfections, it has provided a workable means of establishing broiler prices in the area.

Microfilm $2.00; Xerox $5.40. 109 pages.

A CASE STUDY IN THE SOVIETIZATION OF THE BALTIC STATES: COLLECTIVIZATION OF LATVIAN AGRICULTURE, 1944-1956

(L. C. Card No. Mic 59-4015)

Janis Labsvirs, Ph.D.
Indiana University, 1959

Chairman: Professor Nicolas Spulber

One of the aims of this thesis is to put the comparison of kolkhoz production (i.e., the productivity per unit of land and livestock, total output, the efficiency in the utilization of resources, and the standard of living of agricultural producers) with that of individual farming on as realistic a basis as is possible.

In analyzing agricultural development in the LSSR (Latvian Soviet Socialist Republic) versus that in pre-World War II Latvia in order to make certain judgments about comparative efficiency, the following advantages are encountered.

The material conditions of the initial start of agricultural development in prewar Latvia and in the LSSR were almost the same: (a) The quality and quantity of natural resources, i.e., the amount of land, the quality of soil, climatic conditions, etc., were identical or almost identical in the two cases; (b) the devastation done to Latvian agriculture by World War I was about equal to that caused by World War II; the Soviets started with about the same amount and quality of livestock, machinery, and farm buildings and the same number and quality of human resources as did Latvia after World War I. The main difference in the conditions was that production in the two cases was undertaken under different economic systems. Prewar Latvia represented a capitalist state with small-scale individual farming, while the LSSR represents a socialist state with large-scale mechanized production in the agricultural sector. Of course, the time element (as expressed in the general progress of production techniques with the passage of time) favors the LSSR, but this can only strengthen the conclusions reached in this thesis about the superiority of individual farming as it existed in prewar Latvia.

Second, the analysis of the process of collectivization of Latvian agriculture shows that when the Soviets have acquired political control over a country, the Soviet model is applied mechanically without adaptation to the new set of circumstances. When full-scale collectivization is not introduced in the so-called satellite countries, this is only because local governments, dependent at least for their principal decisions upon the USSR, have lengthened the transitional period from capitalism to socialism.

Third, the relatively small share of agricultural produce distributed to the kolkhoz peasants in the LSSR supports the conclusion that, up to 1957, no important changes took place in the USSR with regard to the rate of accumulation, and that consumers' interests on the preference scale of planning authorities are still rated relatively low.

Fourth, the fact is emphasized that a distribution should be made between the primary and secondary causes for the deficiencies in kolkhoz production and that the abolition of the latter could not solve the problem. On the other hand, the elimination of the primary causes would mean giving up the kolkhoz system as such or undertaking basic changes in the economic policy followed by the USSR government.

Fifth, analysis of the economic policy suggests that motivations underlying Soviet agrarian policy suggests that no changes in the direction of capitalism or a more liberal policy in USSR agriculture can be expected in the near future. Microfilm $4.45; Xerox $15.00. 348 pages.

ECONOMICS, COMMERCE — BUSINESS

A STUDY OF THE USEFULNESS OF ACCOUNTING COSTS FOR PRODUCT PRICING AND CAPITAL FORMATION DECISIONS

(L. C. Card No. Mic 59-4430)

Morton Backer, Ph.D.
University of Pittsburgh, 1959

This study is concerned with the usefulness of cost accounting as the basis for two broad areas of industrial decision-making: product pricing and capital investments. In attempting to evaluate the cost basis for these decisions, consideration has been given to relevant economic and accounting theory. In addition, a survey conducted by the author provides some empirical evidence of the manner and extent to which cost accounting data are being utilized in regard to these two important types of decisions.

The survey consisted of a series of personal interviews with officers and other high ranking executives of 25 leading industrial concerns. Nineteen different industries are represented in the study. The 25 companies possessed capital assets having an approximate book value of 9.5 billion dollars and reflected aggregate gross sales of approximately 11.8 billion dollars.

The individuals interviewed were asked a series of questions relating to the use of cost accounting as a basis for decision-making in the two stipulated areas of business management. The responses cannot and are not represented to be typical of general industrial practices in the United States. There has been a paucity of studies of this type, however, and it was hoped that some indication of the more advanced applications of cost accounting would be disclosed since these companies are among the leaders of their respective industries. Illustrations of such applications appear in the study.

The conclusions drawn from this study are as follows:

1. The value of cost accounting as an instrument in decision-making varies with the nature of the decision, the criteria employed, and the type of cost system in operation. Costs cannot serve as a maximum aid to pricing

and capital investment decisions, however, without at least some modification of the recorded costs.

2. There are certain organic weaknesses in traditional cost systems, at least from a decision-making standpoint, which suggest the use of caution in the application of recorded cost data.

3. The principal inadequacies of cost accounting as a basis for pricing and capital investment decisions, as revealed by the results of the survey, are:

a. It is necessary to adjust recorded costs so as to give effect to anticipated cost trends.

b. The cost allocation process, which is an integral aspects of traditional cost accounting, produces results which are not always compatible with decision-making.

c. The use of predetermined overhead rates produces results which are not readily amenable to decisions in which the effect of changes in volume is an important consideration.

d. The widespread inclusion in product costs of depreciation based on original cost tends to understate such costs in a rising price market and can result in an inadequate recovery of funds for the replacement of existing assets.

e. The cost accounting system does not give recognition to imputed or opportunity costs which are relevant in pricing and capital investment decisions.

f. The cost accounting system is primarily oriented toward the determination of departmental and product costs, and the costs of other decision-making sectors of the business cannot always be readily isolated.

4. The study also reveals the extent to which special cost studies are being undertaken, independent of the existing cost accounting system, in certain decision-making areas.

5. Despite the foregoing comments cost accounting can and should be an indispensable tool in pricing and capital investment decisions. The wider the range of accounts and the more detailed the break-down by cost elements, the more valuable the system becomes.

Microfilm $3.35; Xerox $11.40. 257 pages.

THE DISTRIBUTION OF NEW AUTOMOBILES: A CASE STUDY IN WORKING TOWARD MORE EFFECTIVE DISTRIBUTION

(L. C. Card No. Mic 59-4896)

Robert Lancelot Clewett, Ph.D.
University of Michigan, 1959

The purpose of this study is to suggest a procedure which may be helpful to manufacturers of nationally advertised consumer goods in working toward more effective distribution. More specifically, it is concerned with identifying specific distribution objectives and with working toward effective allocation of resources to reach these objectives. The automobile manufacturing industry is used as a case study. The distribution activities of automobile manufacturers are viewed broadly in relation to their other marketing activities. Attention is directed primarily, however, to the major factors and influences which determine the appropriate type and number of retail outlets and the activities which such outlets perform in facilitating the flow of new cars from automobile factories to new-car buyers. This study is intended to be neither exhaustive nor definitive. It is an exploratory effort, intended to be merely a first approximation.

The research design for this study is based on a procedure applicable to general situations concerned with resource allocation. It consists of identifying general and specific objectives, reviewing the alternative means available with which to work toward meeting these objectives, selecting the most appropriate ones, formulating a general theoretical plan for working effectively toward the objectives, and in suggesting appropriate action for the implementation of the theoretical plan. In view of the nature of the study, emphasis was given to qualitative rather than quantitative considerations.

Several conclusions can be drawn with respect to this study. It was found that in automobile distribution the central problem today is determining, establishing, and maintaining the appropriate type and number of retail outlets to facilitate the flow of new cars from factories to new-car buyers. During recent years, manufacturer-dealer relations have been the central problem only with respect to preserving the present method of distributing new cars, the franchise dealer system. Also, it was found that automobile manufacturers could improve their distribution performance by more fully utilizing product service as a promotional tool in selling new cars. It was found that an appropriate way for automobile manufacturers to accomplish this would be for them to establish two new types of specialized retail new-car outlets, one for sales, another for product service, in areas in which there is a sufficient volume of business to support them. It was found that ownership and management in the case of specialized new-car sales outlets should rest with local independent businessmen, franchised by automobile manufacturers to represent them. With respect to specialized product service outlets, it was found that automobile manufacturers themselves should assume this responsibility.

The formulation and presentation of a theoretical plan for the distribution of new automobiles and the plan for its implementation are major contributions of the study. They demonstrate the importance which firmly based and properly formulated theoretical plans have for manufacturers of nationally advertised consumer goods. They provide a standard against which present distribution policies and practices can be viewed, differences closely noted, and appropriate action taken. They provide a guide to general, long run distribution objectives, which can be highly useful in making changes today which are appropriate for tomorrow's distribution needs as well as today's. Moreover, they point the direction to more effective distribution by focusing attention upon the maximum utilization of resources, in keeping with the tasks to be performed in reaching preselected distribution objectives.

Microfilm $3.10; Xerox $10.60. 240 pages.

PRICE DISCRIMINATION AND MARKETING MANAGEMENT

(L. C. Card No. Mic 59-4902)

Brian Dixon, Ph.D.
University of Michigan, 1959

The purpose of this study is to analyze the role of differential pricing in the selling strategy of marketing management, working within an effectively competitive framework. This excludes those price differentiating actions undertaken by firms exercising unchecked power or acting collusively. Differential pricing is the action of varying the price charged for the same or essentially similar products to different customers. The study is predicted on two basic hypotheses; that differential pricing is essentially promotional in nature, and that differential pricing is properly considered an integral part of a firm's promotional mix (i.e., the combination of techniques used by the firm to promote its product).

As part of the analysis, the general economic logic of differential pricing is examined, although primary emphasis is on the internal efficacy of the technique for marketing management. As a logical outgrowth of this emphasis, the conflict between the use of price differentials by marketing management, and the restrictions of the Robinson-Patman Act is examined.

The study is analytical, supplemented by discussion of cases and examples. The cases are used to point up the need for differential pricing, and also to examine the interaction of firm policy and the administrative and legislative regulations concerning price discrimination. Particularly detailed case analysis is made of the Sealed Power Corporation, and Thompson Products, Inc., both as examples of the need for differential pricing, and as pointed illustrations of the conflict between the Robinson-Patman Act and the firm's policies.

Conventional economic theory does not treat price as a promotional technique similar to non-price techniques, such as advertising, yet both the hypotheses of the study and observable marketing management behavior indicate that it in fact is. The first stage of the analysis, then, offers a reanalysis of price versus non-price rivalry, restructuring this area in line with the firm's promotional use of price. Using this concept of price and non-price, differential pricing is examined. A definition of discriminatory pricing is established, predicated on the use of differential pricing as a purchase of promotion. This is followed by examination of types of discrimination, their use for the firm, and their economic significance.

Having established a logical differential pricing behavior for the firm, the conflict between this and the Robinson-Patman Act is examined, against a framework of FTC and Court cases involving charges under the Act. Although not a comprehensive examination of the range of FTC and Court interpretations of the Robinson-Patman Act, the cases indicate clearly that the conflict is severe, and bears on the whole process of establishing a sound price and promotional strategy.

Three general conclusions are indicated by the study. (1) The use of price differentials by the firm is a logical and necessary response to market, product, and capital conditions, in an attempt to achieve maximum effectiveness in the expenditure of promotional funds. (2) Under effectively competitive market conditions, differential pricing leads to better resource utilization for the economic system as a whole. (3) As a result of the above, there would seem to be little alternative but to sharply modify or reject the Robinson-Patman Act. This would force a return to competitive regulation of differential pricing concerned with the preservation of a generally beneficial competitive structure, rather than regulation to protect directly the status of firms or individuals vis-a-vis others in the distributive process.

Microfilm $2.10; Xerox $7.40. 159 pages.

THE EFFECT OF AUTOMATION ON ACCOUNTING JOBS

(L. C. Card No. Mic 59-3357)

Melvin Lloyd Edwards, Ed.D.
The University of Oklahoma, 1959

Major Professor: Dr. Gerald A. Porter

The problem of this study was to determine the nature and extent of the effect of automation on the bookkeeping and accounting phases of office work in Oklahoma City. Further it involved consideration of the implications for business education as the use of automated equipment is stabilized and educational needs identified more clearly.

The data were derived from an extensive survey of current literature and case-study reports, based on interviews with 42 machine-accounting supervisors, relative to the circumstances surrounding the utilization of punched-card equipment.

Conclusions based on the extensive findings in this study are:

1. Future expansion in the utilization of the relatively new automatic-data processing machines and techniques is assured because both large and small organizations can benefit from the greater efficiency, increased amounts of data, elimination of clerical routine, and the much more rapid preparation of accounting materials and reports.

2. General difficulties and specific problems in the installation of machine units, and later in expanding of stabilized functions of the units, necessitate the development of sources of material aid that can be utilized by management in establishing job classifications and employment requirements, training and re-training of employees, resolving personal reactions to the installation of machines, providing adequate physical circumstances, and the solving of numerous smaller problems unique to this phase of office work.

3. Personal traits, work-habits, and job preparation required by workers in the automatic-data processing field are very similar to those required in other office workers, thus indicating that undoubtedly currently functioning educational facilities can be utilized in occupational preparation of prospective employees.

4. Persons having responsibilities in education for business, at both the secondary-school and collegiate levels, should begin immediately to resolve the vocational education problems resulting from changes in the way routine clerical work is being accomplished.

Microfilm $6.45; Xerox $22.40. 507 pages.

SOME CRITERIA FOR DISCLOSURE OF POST-STATEMENT EVENTS

(L. C. Card No. Mic 59-4716)

William Baker Flowers, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Jim G. Ashburne

Full disclosure of the financial position of a business is a problem of modern accountants. In the early years of the twentieth century the concept of disclosure appeared to be a concept outside the scope of the accountant's responsibility. However, changing social conditions, a change in the attitude of the corporation toward the corporate shareholder, and government regulatory agencies shifted the responsibility for the adequacy of disclosure to the certified public accountant when he was called on to give an unqualified opinion on the financial position of a business and the results of its operations. Some standards of disclosure of the accounts of record have been established. However, the area of post-balance-sheet events has been largely neglected. Some criteria to be used in reaching decisions to disclose post-balance-sheet events was needed in order to achieve uniformity in disclosure.

In 1948 the profession began to realize the importance of post-balance-sheet events as an aid to interpretation of financial statements and the results of operations. After 1950, writers of auditing and accounting textbooks began to include material on post-statement events. The Committee on Auditing Procedure, American Institute of Certified Public Accountants published Bulletin 25, "Events Subsequent to the Date of Financial Statements," in 1954. This Bulletin did not provide standards or criteria for disclosure of post-statement events.

The development of criteria was based on the assumptions that accountants reached decisions to disclose post-balance-sheet events by considering the effect of such events on certain elements of the financial statements, and that they followed some uniform reasoning pattern in making decisions. Three hundred questionnaires were circulated to prove or disprove these hypotheses. The results of the questionnaire did not establish conclusively the existence of a relationship between elements of the financial statements and the subsequent events listed; however, they did confirm a lack of consistency in disclosure of post-statement events, and the existence of some criteria for each of the categories of events.

Subsequent events were divided into two categories. Category I events exist on the statement date, but are unknown to the accountant until the subsequent period. These events are generally subject to measurement in dollars. Category II events do not exist on the statement date. The event or condition was created or happened during the subsequent period. Category II events are of two types, those subject to measurement in dollars and those not measurable in dollars. The basic criteria recommended are based on these divisions of subsequent events.

The study furnishes evidence that accountants do in fact exercise professional judgment in disclosure decisions in a conscious or subconscious pattern and according to certain relationships. General criteria exist for evaluating the results or conditions to decide whether or not disclosure is necessary. The criteria proposed in this study are not necessarily the only ones nor the ultimate judgment standards but they constitute a beginning. They are reasonable and sound and should prove useful to the independent accountant faced with a situation requiring a disclosure decision. Microfilm $2.55; Xerox $8.80. 194 pages.

AN ECONOMIC STUDY OF RESEARCH AND DEVELOPMENT EXPENDITURES IN THE UNITED STATES SINCE WORLD WAR II

(L. C. Card No. Mic 59-4450)

Gino Paul Giusti, Ph.D.
University of Pittsburgh, 1959

This dissertation: (1) presents monetary historical information on research and development expenditures in the United States from World War II to the present, (2) establishes the annual expenditures by the federal government, industry and colleges, universities and other institutions on research and development, (3) establishes the annual performance of research and development by each of the three groups, (4) determines labor's proportion of total research costs per research scientist and engineer employed, (5) determines the movement of industry's research and development expenditures as compared to movements in some business barometers and some business expenditures, and (6) presents some information and thoughts on basic research.

To pursue the first three aims, data were assembled on expenditures for research and development by each group. These gave the total annual expenditure and performance of research and development in the United States. The performance by each group was determined by using the total figure as a guide.

For analyzing the fourth point estimates were made on the cost of performing research per research scientist and engineer employed. By determining the average salary of research engineers over the years, its proportion to the total cost was estimated. Also, the proportion of the total cost made up by the supporting personnel was estimated. The two together make up the total labor cost.

To accomplish the fifth aim comparisons were made between historical data reflecting industry's research and development expenditures and GNP, manufacturing sales, Federal Reserve Board index of industrial production, expenditures for new plant and equipment, and advertising outlays. Not only was the growth of each item noted but also its percentage change from year to year. This study shows that since World War II industry's research and development expenditures have maintained a faster pace than the other comparative items and that all of the items, including research and development, fluctuate with the cyclical movements of the economy.

To develop the final aim, data were presented on basic research; who performs it, how much and who pays for it? Also included are recommendations pertaining to this important phase of research.

The study finds that the nation's research and development expenditures increased from less than $2 billion in 1946 to more than $8 billion in 1959. Of the total current research and development expenditures a little over one-half originated from the federal government. Colleges, universities, and other institutions supported about three

per cent and industry made up the balance. On the performance side industry was responsible for about 71 per cent, the federal government, 18 per cent and colleges, universities and other institutions, 11 per cent.

Less than 10 per cent of the nation's total expenditures on research and development is devoted to basic research. Of the total expenditures for basic research, industry contributed more than 40 per cent, the federal government more than 35 per cent and colleges, universities and other institutions about 25 per cent. Performance-wise, colleges, universities and other institutions were responsible for one-half of the total, industry conducted more than 35 per cent while the federal government performed the remaining 15 per cent.

It was established that from 1946 to 1953 labor costs increased at about the same rate as all other costs in research and development; therefore, labor was not more responsible for the increased costs of research and development per researcher employed. It was determined further, for the same time period and on a constant dollar basis, that there was practically no change in the cost of performing research and development per researcher employed. Microfilm $2.70; Xerox $9.40. 206 pages.

DEVELOPMENT OF A QUANTITATIVE CRITERION FOR THE GUIDANCE OF DECISIONS RELATIVE TO THE INVESTMENT OF HIGHWAY FUNDS

(L. C. Card No. Mic 59-4230)

Charles M. Hummel, Ph.D.
University of Virginia, 1959

The Virginia Department of Highways is interested in research leading to the development of a criterion such as is defined by the title. It should be an accurate, quantitative measurement of the utility of incremental highway investment which will make it possible to evaluate the respective 'returns' to be obtained from alternative investment projects.

The methodology employed follows the recently developed research technique, operations research. An abstract model will be constructed, incorporating most of the basic variables, then this model will be adapted to the situation existing in fact.

A fundamental assumption is that the aim of highway investment is to maximize 'user utility'.

All variables bearing on 'user utility' are defined and evaluated.

The following basic variables are derived:

I. Cost Considerations
   1. Construction Cost
   2. Geometric Design Standards

II. Utility (Benefit) Considerations
   A. Transport Services
      1. Speed Capacity
      2. Safety
      3. Dependability
      4. Comfort
      5. Beauty
   B. Criteria Separating Groups of Users
      1. Vehicle Size and Load
      2. Traffic Density
      3. Traffic Variability

Assumptions delineating the framework for the operation of the model follow.

Descriptive Assumptions
1. Highway investment aims to maximize 'user utility'.
2. Available funds are fixed and limited.
3. The road network is fixed.
4. Minimum acceptable design standards are specified.
5. Maximum practicable design standards are specified.

Simplifying Assumptions
1. All vehicles are homogeneous.
2. All traffic counts needed are available.
3. All other statistical and engineering data needed is available.
4. Maintenance costs bear a constant relation to construction costs.

The assumptions eliminate two variables; Vehicle Size and Load, and Traffic Variability.

Dependability, Comfort, and Beauty are classified as subsidiary benefits. Traffic engineers must employ skilled subjective judgment in establishing adequate levels of these services.

Geometric Design Standards are eliminated because they are the vehicle through which costs are related to benefits.

Traffic Density and Speed Capacity form the basis for a new combination variable - Total User Time Cost.

Safety will be the principle constraint on speed capacity. Traffic engineers must again use skilled judgment in establishing safety requirements for all roads (classed by speed capacities).

The two remaining variables, Construction Cost and Total User Time Cost, become the basis for the computation of a 'cost-benefit' ratio. These ratios make it possible to rank all potential investments. Within the constraint of limited funds, investment in roads showing the highest ratios will maximize the marginal return.

The criterion is defined as follows: Total User Travel Time Savings must be maximized for each investment. Constraints are; limited funds, the required level of Safety, design standards delivering appropriate levels of - Dependability, Comfort, and Beauty.

Re-examination of the two basic variables eliminated by the simplifying assumptions is now necessary, this will make possible application of the criterion to a practical situation.

1. Vehicle Sizes and Loads, the reasoning used here produces a money valuation of User Travel Time Cost for the various types of vehicles using roads.

2. Single Figure Traffic Counts which reflect different degrees of variability in the flow of traffic on different roads is the next problem. A simple hourly average of the yearly traffic flow provides the basic figure. To account for variations in the degree of congestion existing on different roads, another calculation is made. This gives the yearly money cost of user time lost due to congestion. The annual congestion cost figure must then be deduced from the annual cost of the construction, required to eliminate the congestion.

Technical problems, beyond the scope of this paper, involved in the practical application of the criterion are discussed.

A numerical demonstration, using empirical data regarding Virginia roads, illustrating the operation of the criterion is presented.

For comparative purposes, a brief description of the present fund allocation system in Virginia is given.

Recommendations are offered which would expedite adoption of the criterion proposed.

Microfilm $2.00; Xerox $5.60. 113 pages.

CONTROL OF MERCHANDISING IN FOOD CHAINS

(L. C. Card No. Mic 59-4936)

Ruel Conrad Kahler, Ph.D.
University of Michigan, 1959

The control of merchandising is a continuous problem for retailers. It is particularly perplexing for the retail food chains because of their need to adapt merchandising practices to the territories in which their stores are located and still maintain the advantages of large scale operation. The purpose of this study of control is two-fold: (1) to describe the systems used by the food chains to control merchandising and (2) to determine whether the systems in use are appropriate for effective control. To accomplish this purpose a detailed study is made of the systems used in the retail divisions of the food chains. The study provides a comprehensive view of the systems used to control the product mix and inventory levels at both the division warehouse and the retail stores.

Two preliminary chapters provide background information. In one the control system is described as consisting of an environment for control, standards for judging performance, and methods for measuring performance. In the other chapter four organizational structures of chains are evaluated to determine the patterns of authority and responsibility for the control of merchandising.

Investigation reveals that primary reliance for control of the product mix is placed upon the methods used for screening new items and evaluating the existing product lines. Three screening methods are in common use and are evaluated in the study: the single buyer, the buying committee, and the rack jobber methods. The buying committees are used in lieu of carefully defined criteria for determining the ideal product mix. The study reveals a need for clarifying the criteria used to select the product mix and proposes standards based on sales and profit per linear foot of shelf space and the net profit contributed by individual items. The screening process at division headquarters establishes the maximum assortment for the retail stores, but in the more decentralized chains store managers are permitted to select the items which are most in demand in the trading areas of their stores.

The study shows that buyers at division headquarters and retail store managers are responsible for controlling the inventory levels at the warehouse and the retail stores respectively. In contrast to the systems for controlling the product mix, definite standards are established for controlling inventory levels. The standard most commonly employed is based upon stock turnover, although some use is made of merchandise budgeting. Conformance with the stock turnover standard is judged by calculating the number of week's supply on hand at a given time. Data for this figure are derived from billing reports, sales reports and physical inventories. The study indicates the inadequacies of the present controls and suggests some methods for improvement.

In addition to the specific conclusions regarding the control of the product mix and inventory levels, two general conclusions on control may be drawn from the study. (1) Decentralized control of merchandising has become characteristic of food chain operations. The primary locus of this control is divisional rather than central headquarters. To date, only a moderate degree of control over the product mix and inventory quantities in the retail stores is exercised by retail store managers. (2) The methods used to control merchandising are currently in a state of flux. Changes in merchandising policy, the competitive climate of the industry, and the development of new information systems are factors leading to modifications of existing techniques.

Microfilm $3.15; Xerox $10.80. 243 pages.

A STUDY OF THE EFFECTIVENESS OF CONTEMPORARY PROFESSIONAL ACCOUNTING LITERATURE

(L. C. Card No. Mic 59-4524)

Patrick Samuel Kemp, Ph.D.
University of Illinois, 1959

The development and communication of accounting theory depend largely upon professional accounting literature. Thus it is imperative that this literature be written as effectively as possible. The aim of this thesis is to improve future accounting writing by analyzing deficiencies in contemporary accounting literature.

The criteria used to evaluate existing accounting literature are drawn primarily from various exposition textbooks and are modified when necessary to fit the subject at hand. The body of the thesis is composed of illustrations of these criteria selected from contemporary professional accounting literature. The criteria are divided into three categories: fundamental principles, negative elements of style, and positive elements of style.

The fundamental principles category includes methods of attaining the rhetorical principles of unity, coherence, and emphasis. The beginning position may be used to emphasize an important idea or to help guide the reader through the paper by telling him what to expect. The ending position may be used to reiterate the main theme or to emphasize important conclusions or contentions. The writer may use space to emphasize important points and to subordinate less important ones. A logical sequence of presentation both reminds the reader of the central theme and helps him to follow the development of that theme.

Negative elements of style must be eliminated in order to reduce ineffectiveness. The writer should avoid using sentences whose very length and complexity make them difficult. He should also avoid using more words than are necessary to express precisely his intended thought. He should not use long, pretentious, or obscure words when short, simple, familiar substitutes are available. To eliminate vagueness, one must develop his ideas precisely and then choose and combine his words carefully. The elimination of the four preceding elements will eliminate their combination, jargon.

After eliminating the negative elements, the writer may use positive elements of style to increase effectiveness.

Direct comparison, direct contrast, and analogy may be used to lend interest to a paper and to clarify difficult or unfamiliar points. The writer may cite authority either to give due credit for borrowed ideas or to lend weight or emphasis to arguments and statements. Illustrations and examples may be used to amplify brief statements, to make general statements more specific, and to clarify difficult ideas and complicated procedures. The writer should avoid evasive, impersonal approaches designed to make his writing appear objective. Instead, he should write forcefully and directly by adapting his style to his subject matter. Accounting terms should be selected carefully and used consistently throughout a paper, as an initial step toward developing a consistent technical vocabulary for the entire profession.

Although the above statements appear in this thesis as criteria for evaluating the effectiveness of existing accounting literature, they are equally applicable as suggestions for improving future writing in accounting.

Microfilm $2.00; Xerox $7.00. 150 pages.

THE EMERGENCE OF SYSTEMATIC MANAGEMENT AS SHOWN BY THE LITERATURE OF MANAGEMENT FROM 1870 TO 1900

(L. C. Card No. Mic 59-4529)

Joseph August Litterer, Ph.D.
University of Illinois, 1959

Studies of the literature of management have given little attention to the historical development of management thought. What work has been done has usually been on the development of scientific management and the work of such men as Fredrick W. Taylor, who advanced this concept. This study is directed to the period before the establishment of scientific management as a recognized movement, in an attempt to answer two basic questions: (1) Was there a body of management literature immediately preceding the emergence of scientific management? (2)Did this literature, if it existed, have a central concept or approach which could be recognized?

A search of materials published in the United States and Great Britain between 1870 and 1900 revealed a considerable body of management literature. This literature has no apparent relationship with known management literatures written earlier in Great Britain, France and Germany. It contains the earliest known treatment of management as a separate and recognizable function in the operation of a business enterprise. Further, although it was broad in scope, much of it is concerned with the necessity of, and a search for ways of achieving internal coordination. This represents a distinct approach to management which can appropriately be called Systematic Management.

Systematic management was a search for a way to insure that all necessary work would be done and on time by either providing top company officials with the necessary information with which to direct and control the firm's activities or by providing managerial procedures which will do this for them. It was also an attempt to relieve managers of many repetitive tasks. Systematic management was fundamentally concerned with finding ways to operate an existing organization to accomplish established objectives or in accordance with standards established by company managers. When considered in light of a common list of management functions (planning, organizing, staffing, directing and controlling), it was found to be concerned only with directing and controlling.

In examining various systems, two components were uniformly used: (1) a position description with a standardized way of performing duties of the position, and (2) specific methods of gathering, handling, analyzing, and transmitting information. Individually these elements are useful in their own right in assuring precise handling of work and reduction of confusion; however, when combined into a system, their value as a managerial tool increases greatly. Supplying information more or less automatically to a person in a position who knows what to do when he receives it, creates a condition where it is possible for part of the work of an organization to be done without the direct attention of higher officials.

Individual systems usually went through a typical pattern of development. When first created they were assigned to regular members of the line organization. Usually in time the operation of the system was placed in the hands of specialists who were the origin of many of the staff departments existing today.

The emergence of systematic management was set against a background of the post Civil War industrial expansion. Apparently as a response to the problems facing them, managers of industrial firms began to create, and to describe in writing, solutions to these problems. This published material was found to be the beginning of the continuing development of management literature which has extended to this day. This evolution of modern management literature has mirrored the transition of the practice of management from traditional or rule-of-thumb management, through systematic and scientific management to sociological management.

Microfilm $4.15; Xerox $14.00. 321 pages.

STATISTICAL QUALITY CONTROL IN COTTON MARKETING

(L. C. Card No. Mic 59-4726)

David Chi Luan, Ph.D.
The University of Texas, 1959

Supervisor: Dr. John R. Stockton

The purpose of this study is to show how the application of statistical methods, especially the method of quality control, can aid in the solution of the cotton merchant's problems associated with assembling and classifying cotton into even-running lots with specific fiber properties.

The existence of cotton marketing in which the cotton merchant plays a predominant role is based upon the special characteristics of the demand for a large quantity of cotton with specific fiber properties as raw material for the cotton textile mill and of the supply as provided by individual farmers. Individual farmers produce a small quantity of cotton with various qualities determined by the differences in variety and the environmental growth conditions under which it is produced. The function of the

cotton merchant is to assemble a few heterogeneous bales of cotton from each individual farmer and to classify them into even-running lots of cotton with specific fiber properties in order to satisfy the technical requirement of the cotton textile mill to make specific end products.

In order for the cotton merchant to deliver even-running cotton with regard to fiber properties, it is imperative that he knows how to measure them. Various laboratory instruments are being used to measure fiber properties. Knowing how to measure fiber properties is insufficient to assemble and to classify cotton at the least cost. But when cotton with a specific fiber property is required, one needs to know where to find what kind of cotton one should measure. The study of the variation in fiber properties leads to the conclusion that variety and environmental growth conditions determine fiber properties. Therefore, when the environmental growth condition is known, it is possible to forecast the fiber property of a given variety. Cotton with probable fiber properties approximated to specified fiber properties is what the cotton merchant should measure. The analysis of the variation in fiber properties makes possible the formation of the concept of homogeneity in fiber properties.

The empirical knowledge of within-bale variation in fiber properties of homogeneous cotton, based upon certain method of sampling, can be used as the basis to utilize the control chart method, to assist the cotton merchant in putting up even-running cotton, to determine the homogeneity of incoming raw material by the cotton textile mill, and to settle disputes between the cotton merchant and his customer by the arbitration authority. If the control chart method is to be effectively used to determine the homogeneity in fiber properties of unknown cotton, the error of measurement, due primarily to the variation in the measuring instruments, the technician's skill, and the conditions under which the measurement of fiber properties is made, should be reduced to a minimum.

The cotton textile mill insists that the cotton merchant supply even-running cotton with specific fiber properties, because the value of fiber properties not only determine the machine settings and qualities of end products but also relates to processing cost. The cotton merchant is required to sell a certain quantity of homogeneous cotton with specific properties before the time of harvesting for forward delivery. It is necessary, therefore, for the cotton merchant to forecast the quantity of cotton production by variety with the trend equation and acreage, so that he may not oversell or undersell in relation to the supply of cotton with specific fiber properties. Once the harvest is under way, the varietal map, together with the knowledge of environmental growth conditions plus government statistics on quantity and qualities of cotton production, can be best used to obtain needed cotton.

Microfilm $4.05; Xerox $13.80. 316 pages.

THE NATURE OF ASSETS

(L. C. Card No. Mic 59-4535)

Raymond Leroy McGarvey, Ph.D.
University of Illinois, 1959

The basic purpose of this thesis is to examine the nature of the concept designated by the term "asset" in the field of accounting. There is a noticeable tendency in accounting to confuse the nature of assets with the valuation of assets. The primary concern in this thesis, however, is the nature of assets and any consideration of asset valuation is incidental to the investigation into their nature. Within the scope of this thesis a further distinction must be made between words and meanings. Asset is both a word, an arrangement of letters found in the English alphabet, and a concept, a mental interpretation of things or a class of things found within our experience.

At the outset a few essential matters are considered about words, concepts, and the process of defining. Following these preliminary considerations an effort is made to evaluate the current usage of "asset" in accounting literature and to ascertain how this usage came to be what it is. Many writers avoid any explicit consideration of this term, probably because they feel everybody knows what such an ordinary word means without explanation. Accountants, like others, sometimes take terminology lightly and the apparent content of many authors to proceed with incompletely-defined terms explains in part why it was felt necessary to give some attention to words and concepts, and their association.

An inquiry into the derivation of the word "asset" shows that it originated in law, and an effort to trace the evolution of the concepts that have commonly been attributed to this word since its appearance in the English language shows that it has been used fairly consistently in law and in general to designate property that is to be used or that can be used in the satisfaction of debts. Unfortunately, the majority of accountants who attempt to define asset accept this concept despite the evidence that accountants apply the term to not only the means available for settling debts but the means available for furthering all operations of an enterprise of which the settlement of debts is only one. The explanation of this contradiction between the accounting definition and the accounting usage of "asset" seems to lie largely in its extension to new situations without explicit acknowledgement of a changed meaning.

Some discussion is devoted to a method that physics has found useful in clarifying some of its concepts. This method, known as "operational analysis," is essentially only a matter of giving a verbal recount of the human experience which has produced a concept. The balance of the thesis is then devoted primarily to an examination of the experience which determines the accounting concept asset. Accounting is essentially a device used for the collection and disclosure of information on man's economic activities and, accordingly, this is the experience that determines any accounting concept. An examination of man's economic experience finally results in the following definition:

> An asset is any currently-existing source of future service for which current conditions warrant an expectancy by an enterprise of the availability of this service for expected operations. Such a source of service is an asset only to the enterprise or enterprises holding the expectancy.

The thesis is concluded with a discussion of the recognition of assets in the accounts and of some of the implications of the proposed definition.

Microfilm $3.50; Xerox $11.80. 270 pages.

CONSUMER CREDIT INSURANCE IN NEBRASKA

(L. C. Card No. Mic 59-4394)

John Brubaker Minick, Ph.D.
University of Southern California, 1959

Chairman: Professor Phelps

Since World War II there has been a very rapid increase in the use of life and disability insurance in connection with consumer credit transactions. This special type of insurance, called consumer credit insurance, names the credit-granting institution as the first beneficiary and provides that an insured person's debt will be paid in full if he should die, or that periodic installments will be paid if he should become disabled. It is divided, thus, into two major categories: credit life insurance and credit accident and health insurance. Credit granters can make the insurance available to their customers by offering individual policies, or by offering certificate of insurance under a group policy. In either case, the insurance is issued without benefit of a medical examination, with no restrictions for physical impairments or occupational hazards, and with a uniform charge regardless of the debtor's age.

Individual credit life insurance policies were first written in 1917 for the benefit of loan customers of Morris Plan banks. Group policies were introduced in 1926, and accident and health coverage was developed in the late 1930's. The amount of credit insurance in force increased vastly following World War II, and it is now written by more than 350 insurance companies. Its recent growth is attributed to the increased use of consumer credit, the benefits provided by the insurance, the number and variety of creditors offering it, the public's desire for security, and the enactment of favorable state legislation.

In Nebraska credit insurance is made available by virtually all consumer finance companies, industrial loan and investment companies, sales finance companies, and credit unions. It is also offered by most banks and by a few retail stores. There are many indications that the majority of consumers desire to protect their debts with credit insurance. It was found, through a mail survey conducted among 1,000 Nebraska residents, that 53 per cent of those who had no experience with the insurance, and 95 per cent of those who had, would choose to purchase credit insurance in connection with a future debt.

Consumer credit insurance is incompletely regulated in Nebraska by a variety of laws, most of which apply to a single type of credit-granting institution. Despite this situation, abuses of the insurance either are minor in nature or occur infrequently.

The abuses that do occur could be further reduced if the various laws were replaced by a comprehensive act regulating all credit insurance. Such a law should authorize the Department of Insurance to establish maximum charges for credit insurance sold in the state. A ceiling over charges would automatically limit the compensation received by creditors selling the insurance. The law should also specify that (1) coverage must never exceed the amount of the debt or the term of indebtedness, (2) creditors must give insured persons a copy of the policy or a statement describing the coverage, (3) insurance must be canceled and unearned charges refunded when debts are prepaid or refinanced, and (4) debtors must be permitted to acquire the insurance from sources other than the creditor. Microfilm $4.10; Xerox $13.80. 318 pages.

AN EVALUATION OF THE REGULATIVE ASPECTS OF ACCOUNTING REQUIREMENTS FOR PUBLIC UTILITIES IN THE UNITED STATES

(L. C. Card No. Mic 59-4568)

Hussein Amer Sharaf, Ph.D.
University of Illinois, 1959

The purposes of this study are to appraise the accounting requirements currently applied for public utilities, and to investigate the potential of general accounting theory for the solution of controversial problems in public utilities regulation.

The background of the study points out the economic characteristics of public utilities, traces the efforts made in developing present accounting requirements, and explains the changing attitude of the accounting profession toward these requirements.

The principal controversial issues in public utility regulation are concerned with (1) the standard of reasonableness and its application in rate proceedings, (2) the original cost rule, (3) the recognition and accounting treatment of intangibles, and (4) the depreciation base, especially during inflation.

With respect to each of these issues, the study presents the claims of public utilities, the reaction of regulatory commissions, the positions of courts, and the solutions currently adopted. The regulatory rationale behind such solutions is analyzed and appraised in the light of the economic characteristics of public utilities and the theory of regulation. These solutions are compared and contrasted with those currently accepted in conventional accounting for similar problems. Appropriate solutions are proposed.

The study indicates that in order to eliminate or minimize current litigation, regulation should be conducted primarily on an educational rather than a policing basis. More emphasis should be placed on technical guidance and supervision. The study makes a plea for constructive regulation through accounting data using the theory and technique of standard costing, and management-type audits by regulatory auditors.

Due to the unique positions of investors and consumers in public utilities, the study concludes that the resources of this class of business-enterprise is in the nature of a trust fund which should be maintained unimpaired. This is the main theme underlying the several solutions proposed in the study. In their entirety these solutions provide a coordinated approach to public utility accounting problems. They aim at and should result in maintaining the integrity of the real investment in public utilities and determining the cost of the service on an equitable basis. As such, they conform to the fundamental objectives of regulation: equity to the consumer and healthy survival of the producer.

The study indicates that the basic concepts of conventional accounting theory are capable of contributing to the improvement of the regulatory process when they are adequately adapted to the characteristics of public utilities.

Microfilm $5.20; Xerox $18.40. 408 pages.

THE RATE OF RETURN OF PRIVATE ELECTRIC UTILITIES IN THEORY AND PRACTICE IN THE UNITED STATES

(L. C. Card No. Mic 59-5002)

William Carroll Tuthill, Ph.D.
University of Michigan, 1959

The purpose of this study is to determine what rate of return concepts have guided commissions during business expansion and inflation in their determination of maximum allowable rates of return for public utilities. The study is concerned with two problems: (1) What are the principles that guide regulatory policies? (2) What will be the effect of the techniques employed by regulatory groups in deriving maximum allowable rates of return?

The successes of the private electric utility industry in expanding capacity, in raising capital and in rewarding investors during the postwar years of 1946-55 are reviewed and contrasted with these same measures of success of all industry and all manufacturers. Despite offering lower monetary rewards and despite continuing inflation, the utilities were able to obtain relatively more capital in the markets than the other groups during this period.

Selected court and commission decisions involving the rate of return problems for public utilities are reviewed and analyzed from Munn v. Illinois in 1877 through the decisions of 1955, with primary emphasis upon those following 1939. Techniques and methods, as well as guiding theories, employed by the various commissions for deriving an adequate return for utility companies are described and criticized from the viewpoint of continuing expansion and continuing inflation.

Maximum returns allowed and rate bases employed for private electric utility companies by the regulatory commissions from 1931 through 1955 are reported. Returns allowed are shown to have declined materially both during depression and during prosperity. The rate base adopted swung heavily towards book value with the beginning of inflation and war expansion, becoming almost universal after the Hope Case. Not until after 1950 and prolonged inflation was there a partial return to the traditional "fair value" base.

An analysis is made of ten electric companies operating under the jurisdiction of ten different commissions to determine whether the rate base theories espoused by the responsible commission have affected noticeably the returns realized by the companies.

Two general conclusions can be drawn from the study: (1) Adoption of the "fair value" rate base by a commission does not necessarily result in a high rate of return for the companies under its jurisdiction. (2) The current cost of capital technique as employed in the determination of a "fair and reasonable" return cannot result in either a "fair" or a "reasonable" return during a period of expansion and inflation.

Microfilm $3.30; Xerox $11.20. 255 pages.

THE HOTEL-RESTAURANT MEAT PURVEYOR: AN ANALYSIS OF THE GROWTH, OPERATION, AND FUTURE DEVELOPMENT OF A SPECIALIZED TYPE OF MEAT WHOLESALER

(L. C. Card No. Mic 59-4850)

Leon Paul Ullensvang, Ph.D.
Northwestern University, 1959

Supervisor: Ralph Westfall

The objective of the dissertation is to examine in detail a specialized type of meat wholesale agency, commonly known as the hotel-restaurant meat purveyor, which has grown to be an important part of the meat distributing industry within the last thirty years. The study is concerned with answering the following questions:

(1) What are the forces that caused the rapid growth in importance of the hotel-restaurant meat purveyor in the already established meat distributing industry?

(2) How does this specialized type of wholesaler operate and what functions does he specifically perform in the distribution of fresh meat and meat products?

(3) What is the probable future of this type of specialized wholesaler both absolutely and relative to the rest of the wholesalers in the meat industry?

Because there has been almost no published material which directly relates to the hotel-restaurant meat purveyor, the analysis relies heavily on primary data obtained from a nation-wide mail survey of hotel-restaurant meat purveyors. Personal interviews as a supplement to the mail questionnaire data and the available published data provide detail and background material.

Hotel-restaurant meat purveyors are meat wholesalers who sell all or almost all of their output to members of the food service industry. It is estimated that there are at least 1000 such firms whose chief function is that of preparing and fabricating meat cuts and selling them to the food service industry. These firms have come into existence in the distribution of meat to perform certain services for purveyors of meals who lack the facilities for performing such services for themselves or who find it less expensive and more efficient to have a specialist at the wholesale level perform them. These services include the selection, aging, boning, and fabrication of carcass or primal cut meats into roasts, steaks, chops, and other individual cuts as well as otherwise preparing the meat ready for cooking. Special services in terms of credit and delivery are also important parts of the meat purveyor's operations. The special needs and demands of the food service industry in terms of product and service are important factors in determining the sometimes unique functions and services performed by hotel-restaurant meat purveyors. In addition to the growing demand for a specialist by the expanding food service industry, the rationing and price control regulation of World War II, and recent changes in the channels of distribution for fresh meat and meat products have been also important factors in the recent growth in importance of the meat purveyor.

Despite a threat of increased competition from other types of meat distributors, there are sufficient reasons to believe that meat purveyors will continue to be an important part of the meat distributing structure. However, in

view of the changes in the food service industry requirements for product and service, and changes in products and production technology, it is likely that purveying firms will change somewhat from their current form of operation. Among these changes will be an expansion of fabrication services, expansion of product lines, and a growth in the average size of meat purveying firms.

Microfilm $5.20; Xerox $18.40. 406 pages.

DETERMINATION OF TRAINING NEEDS OF THE FIRST LEVEL OF SUPERVISION IN MEMBER COMPANIES OF THE SOUTHERN GAS ASSOCIATION

(L. C. Card No. Mic 59-4754)

Wilfred Harvey Watson, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Edwin W. Mumma

This was a case study approach concerned with the analysis of training needs for the first level of management in a number of companies in the gas industry. It involved the feasibility of using a questionnaire administered through personal interview as a means for obtaining the basic information. It was also concerned with the identification of subject matter areas with sufficient clarity to serve as a guide in the development of a training program.

The questionnaire, which included ninety-eight items divided into seventeen topics, was formulated with the cooperation of a committee from industry with field testing as a major aid in final form. It was administered through interviews with 218 men ranging organizationally from the first level to the top level of management. Thirteen companies cooperated directly while ten companies participated indirectly in the study. Geographically, five states were represented in the survey.

Data were tabulated for "Necessary," "Good But Not Required," and "Unnecessary" answers in the repository tables for all levels of management combined and for each level of management individually by the basic functions of distribution and transmission. From the repository tables rank-order tables were constructed from which several general tests were developed and applied to determine topic preference for subject matter training. Responses to a check question dealing with the single most important topic for supervisory training were studied to assist in determining reliability of previous topic findings. Data were analyzed specifically by age, education and length of service.

Final array of subject matter topics by importance was determined by comparison of general tests. Validation of topic importance was secured through analysis of the items composing the topics included in the study. Determination of preference for methods of instruction and type of instructor preceded the development of a tentative pilot program of training for the first level of management based upon the results of the study adjusted to the suggestions of the industry committee.

The general tests applied in the study determined a very definite pattern of topic preference which was supported by the check question analysis. There was an overall agreement on a core of four topics which, in terminology of the study, were Leadership, Job Relations, Gripes, and Orientation. This agreement held generally among the levels of line management between the functions, but the differences developed in patterns as acceptance became less pronounced. The older supervisors, and those with more length of service, felt that more subjects were important to supervisory training than did younger managers, and those with less length of service.

The first four most important topics pointed strongly toward a pattern of emphasis upon interpersonal and human relations. This emphasis continued to be reflected through the degree of acceptance of topics as measured by the rank of the remaining individual topics in the survey. The five additional topics of the most important nine in rank-order were Safety, Controlling, Costs, Human Behavior, and Giving Orders.

The study showed the preferred method of instruction to be a combination of lecture, conference, and case discussion. The company training specialist was preferred over any other type of instructor.

The fact that the participative method of determining training needs developed a definite pattern of agreement and disagreement between different companies in the same industry provides indication that this approach is a tool which has broad potential for business and industry.

Microfilm $4.35; Xerox $14.60. 339 pages.

ECONOMICS, FINANCE

AN ECONOMIC APPRAISAL OF PUBLIC FINANCIAL AGENCIES IN THE HOUSING SECTOR OF THE UNITED STATES ECONOMY: THEIR ORIGIN, OPERATIONS, AND CONTRIBUTIONS SINCE 1930

(L. C. Card No. Mic 59-3511)

Robert Allen Carr, Ph.D.
University of Southern California, 1959

Chairman: Professor Garis

The purpose of this study were (1) to examine the origin, nature, and importance of the Federal financial agencies and programs related to housing finance; (2) to evaluate the nation's twenty-five years' experience with the agencies and programs; (3) to analyze the policies of the agencies and programs to determine the relationship between housing policies and major economic policies of the Federal Government, and the relationships between private mortgage credit policies and Federal policies; (4) to determine the nature and extent of contributions made by the Federal agencies and programs to better organization and increased efficiency in the mortgage credit system of the United States, including an exploration of the direction and force of trends in mortgage credit and the possible consequences of these trends for the future of the Federal programs.

Summary of Findings. Agitation for a mortgage credit system was started in 1918 but was not successful until the establishment of the Federal Home Loan Bank System in 1932. Other agencies and programs studied were Home Owners' Loan Corporation; Federal Savings and Loan

System; Federal Housing Administration; Federal Savings and Loan Insurance Corporation; United States Housing Authority, succeeded by the Public Housing Administration; Federal National Mortgage Association; Veterans Administration Loan Guarantee Program; and the Housing and Home Finance Agency, including the Urban Redevelopment and Community Facilities programs. The HOLC was the only agency studied which was inactive in 1957.

Federal activities in the housing sector included investments, insurance of accounts, insurance and guarantees for mortgages and bonds, regulation of mortgage terms, interest rates, and collateral for advances, direct mortgage loans, housing subsidies, and the purchase of mortgages. Both financial institutions and mortgage practices were affected by the Federal agencies and programs. The Federal Home Loan Bank System and its members were the dominant factor in the mortgage credit system in 1957.

A study of the relationships among Federal monetary, fiscal, and mortgage credit policies revealed conflicting as well as complementary influences. The purpose and structure of the mortgage credit system were described and the present status of the system evaluated. Contributions were enumerated and unresolved problems mentioned. An analysis of trends in mortgage credit showed that while the insurance of mortgages was relatively important in the depression, it was declining in importance by 1957. The dominant institutions in mortgage credit were found to be the savings and loan associations, with Federal associations holding the largest share of assets. Life insurance companies and commercial banks were of increasing importance in mortgage credit by 1957. Individuals, nonfinancial enterprises, Federal agencies, and mutual savings banks were of declining influence in mortgage credit by 1957. Disposition of both properties acquired and mortgages held in Federal portfolios was studied.

Conclusions. If the widest possible influence of the Federal housing activities, in terms of induced and direct changes in money flows, is assumed, the study reveals only a modest record of achievement. The activities of the Federal agencies and programs appear to have been contracyclical in the low periods and procyclical in the high periods of the business cycle. The analysis presented showed the Federal programs contributed to both overexpansion and recovery in the housing sector.

The mortgage credit system was found to have been improved by the creation of the Federal Home Loan Bank System and the Federal Housing Administration's standards of valuation and underwriting for mortgages. Unresolved problems were the procyclical influence of the Federal agencies and programs, the continuing absorption of insured and guaranteed mortgages by the Federal National Mortgage Association, the unstabilizing effect of fixed interest rates, and the lack of a national secondary market for all mortgages.

Microfilm $4.00; Xerox $13.40. 310 pages.

FINANCING PROVINCIAL AND LOCAL GOVERNMENT IN THE REPUBLIC OF VIETNAM

(L. C. Card No. Mic 59-4898)

David Chamberlin Cole, Ph.D.
University of Michigan, 1959

The purpose of this study is to describe, analyze, and consider ways for improving the revenue systems of provincial and local governments in the Republic of Vietnam. The reasons for undertaking such a study were to provide better understanding of the economic role of governments below the national level, and to see how they might contribute more effectively than they do presently to the welfare and economic development of the country.

The first part of the study presents financial data for the provincial and local governments in Vietnam and describes the main sources of revenue. Most of the data pertains to the year 1956. Sample tax laws are presented, and tax regulations and administration in different parts of the country are compared. The second part of the study estimates future revenue needs and analyzes the existing revenue systems in terms of their administrative efficiency, equity and effects upon economic activity. The principal weaknesses and desireable features of the existing revenue sources are pointed out, and general suggestions for improving the systems are offered. Finally, specific recommendations for changes in existing taxes and introduction of new taxes are offered.

The main findings of this study are as follows: There were four levels of government below the national level that had budgets in 1956. These were the provinces, the prefecture of Saigon, municipalities, and villages. Deficits occured at all levels of government equal to approximately one-half of expenditures. Taxes account for half of the provincial and local revenues. The major taxes are the business license tax, the taxes on agricultural land and urban property, and various export and import taxes. Most of the remaining provincial and local revenues are derived from charges for the use of government-owned property (e.g. market places, farm land, houses), or for the privilege of carrying out certain types of business activity. The principal defects of the existing provincial and local revenue systems are that the different taxes and charges are too numerous for effective administration and too vague or complicated to be applied equitably. Certain taxes and forms of subsidization contribute to inefficient allocation of resources. On the other hand, heavier taxation would tend to expand the supply of productive effort, provide for an increase in the rate of capital accumulation, and reduce dependence on foreign aid. Taxes can also be used to bring about redistribution of land ownership.

Four main taxes are recommended for the provincial and local governments: a progressive tax on the value of agricultural production, a tax on the net product (value-added) or gross receipts of businesses, a tax on the rental value of urban property, and a head tax. Also the governments are urged to dispose of their agricultural land holdings and to increase the charges for use of other government property.

Microfilm $3.95; Xerox $13.40. 308 pages.

INVESTMENT IMPLICATIONS OF THE VARIABLE ANNUITY

(L. C. Card No. Mic 59-4909)

Cedric Valjean Fricke, Ph.D.
University of Michigan, 1959

This study endeavors to examine quantitatively the demand for the variable annuity, the potential size of the accumulated funds, and how much effect the accumulated funds will have on the flow of funds in the savings-investment market.

Proponents of the variable annuity claim that the need for this type of contract by the investing public is great enough to justify its sale. Opponents argue that sales of the variable annuity contract will be so large that to invest the proceeds variable annuity companies will find the supply of purchasable shares inadequate.

The first part of the study describes the present position of the variable annuity and its relationship to the savings and investment flow of funds.

The next part of the study projects the accumulated funds and the demand for stocks by variable annuity companies through 1975 based on the probable demand and operations of the companies. Along with this projection are estimates for 1975 of the holdings of equity securities by life insurance companies, fire and casualty insurance companies, non-insured pension funds, investment companies and personal trusts assuming the non-existence of the variable annuity. The total available supply of stocks outstanding in 1975 is also projected. These estimated are then modified to take into account the demand by the variable annuity companies.

The final section describes two cases where a large institutional investor is continually buying a particular stock. The analysis of these two cases indicates that the large institutional investor has no measurable effect on the price of a stock even if the institution accounts for 25 per cent of the stock traded on the exchanges.

The study concludes that until at least 1975 the demand for stocks by variable annuity companies will be small compared with the total available and compared with the demand by other institutional investors. Neither will the demand for stocks by variable annuity companies alter the flow of funds in the savings-investment market to any appreciable extent.

Microfilm $2.00; Xerox $6.40. 134 pages.

AGRICULTURAL LAND REVENUE IN THE BOMBAY STATE

(L. C. Card No. Mic 59-4636)

Tryambak Mahadeo Joshi, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. A. G. Buehler

The present dissertation is a study of the system of assessment and collection of agricultural land revenue in the Bombay State.

The State of Bombay is one of the constituent States of the Indian Union. Under the Constitution adopted in 1950, taxation of agricultural and non-agricultural land falls within the purview of State Governments. In the Bombay State, the principles and techniques of levying revenue from agricultural lands have been based on the system known as the Rayatwari System, adopted by the British when they took over the administration of the territories from the native rulers in the early nineteenth century. The evolution of this system has been traced in detail in Chapter 3. In the subsequent chapters, the levy is examined in respect to its nature, incidence and effects. In Chapter 4, the conception that land revenue is of the nature of rent charged by the State in its capacity as the owner of all land is refuted and it is established that land revenue has all the essential attributes of a tax. In Chapter 5, the incidence of land revenue is examined, and the conclusion is reached that by and large its burden rests on occupant of land and that it is not shifted. In Chapter 6, the actual burden of land revenue on the cultivating occupants is examined with the help of available data relating to the ration of land revenue assessments to net profits of agriculture, farm business incomes, and rental values. The conclusion is reached that at current levels of prices, costs and incomes, land revenue assessments involve a comparatively light burden on the farmers. Later, in Chapter 7, an attempt is made to analyse the effects of land revenue policy and administration on the rural economy of the State. The next chapter is devoted to a study of land revenue as a source of income of the Bombay State. In this connection, the diminished importance of land revenue receipts in the fiscal set-up of the State in recent years is brought out, and its inelasticity and non-adaptability to fiscal need is commented upon. Chapter 9 is devoted to an analysis of land revenue in the light of acceptable principles of taxation. Here, the levy is examined in terms of the maxims of certainty, convenience, economy, and equity, and its shortcomings are brought out. Similarly, other defects of the levy, especially its rigidity and non-adaptability to fiscal needs, are laid bare. This chapter thus attempts a general appraisal of land revenue as a tax. This leads to the problem of reform in the system of assessment and collection of agricultural land revenue. This problem is approached in two directions: on the one hand, modern trends and principles of land taxation in different countries are studied and their bearing on the problem of land revenue reform is brought out; on the other hand, the necessity for increasing the tax contribution from agriculture in the context of India's plans of economic development provides another approach to the problem of land revenue reform. In the light of these two approaches, a scheme of reform is worked out and its place in the general structure of land taxation is indicated. It is suggested that the present assessments should be "standardised" in the light of the changed price-and-cost structure, and revisions should be undertaken on a State-wide basis every ten years in terms of changes in the prices of representative agricultural products. It is also suggested that land revenue should be supplemented by taxation of agricultural incomes in all States. As a long-run solution, it is maintained that this latter should be incorporated in the central income tax, so that agricultural as well as non-agricultural incomes will become subject to the national structure of personal income taxation.

Microfilm $4.35; Xerox $14.60. 337 pages.

THE FINANCING OF PUBLIC INVESTMENT IN COMMUNIST CHINA

(L. C. Card No. Mic 59-4954)

Feng-hwa Mah, Ph.D.
University of Michigan, 1959

For the underdeveloped countries determined to accelerate their industrialization, there are two roads: one is some sort of mixed economy compatible with democracy, the other is planned development under totalitarianism. What has been happening in Communist China during the past few years is a striking example of the second alternative, and its degree of success will undoubtedly have far-reaching influences on other economically backward countries desiring rapid economic development. Since rapid economic development is unattainable without substantial investment, the sources of investment funds are of crucial importance in the whole program. The purpose of this study is to examine an important phase of economic development in Communist China--its financing. The period covered is that of its First Five-Year Plan, 1953-1957.

The central task of this study is to organize and analyze the available data on the sources of funds for government capital investment, and to explain the way in which pressure was put upon the Chinese population to consume less or relatively less so that a high proportion of China's national income could be mobilized for investment purposes without incurring serious inflation. An appraisal of Communist China's program of investment financing is also undertaken.

The method employed in this study unavoidably depends on the nature and availability of the data. Almost all the information at our disposal has come from Communist China. The method is largely that of examining the evidence for its inner consistency. Fragmentary information in the form of ratios and percentages from reports, budgets and other documents has been fitted together and subjected to simple analysis.

Part I of this study is concerned with the financing mechanism and related policy problems. Sources of funds mobilized and allocated within the framework of the State budget are examined. Farm price policy, wage policy and the role of the banking system are described and analyzed.

In Part II of this study, a general view of the First Five-Year Plan and the magnitude of government capital investment under this Plan is presented. The meager quantitative information available in connection with the domestic sources of financing is organized in the form of summary tables. External sources of financing are also estimated and discussed.

The last part, Part III, is an appraisal of Communist China's investment financing. This has been done from four angles: (1) The distribution of national product between investment and consumption, (2) capital requirements and available resources, (3) indications of inflation, and (4) comparative financing patterns of two development plans for China: a Nationalist post-war Five-Year Plan and the Communist First Five-Year Plan.

The main findings of this study are: (1) much of the domestic financing in Communist China was concerned with the transfer of resources out of the agricultural sector. But as the State enterprises grew, they became increasingly able to plow back funds from their own operation and less dependent on the transfer of resources from agriculture. (2) Under the Communist program nearly 99 percent of the investment funds were secured at home. This was done at the high cost of sharp reductions in consumption and the loss of free choice on the part of the population. On the other hand, if China, under a non-Communist system, were to undertake similar development plan, about 86 percent of the funds would have had to come from abroad. But in this case, the consumption of the population could have been maintained.

Microfilm $3.35; Xerox $11.40. 259 pages.

AN EVALUATION OF THE FEDERAL EXCISE TAX ON THE TRANSPORTATION OF PROPERTY WITH PARTICULAR REFERENCE TO ITS EFFECTS UPON THE USE OF PRIVATE TRUCKING

(L. C. Card No. Mic 59-4533)

Howard Jennings McBride, Ph.D.
University of Illinois, 1959

The freight tax enacted December 1, 1942 remained in force over fifteen years until its repeal on August 1, 1958. It was a 3% excise levied on for-hire carriage of freight within the United States by rail, highway, water or air. This study presents an evaluation of the tax, with particular reference to the effects upon use of private trucking. Secondary sources, especially Interstate Commerce Commission statistics, are used extensively. However, in the analysis of the effects of the freight tax on the use of private trucks, much of the data was secured from primary case studies. Eighty-two traffic managers representing shippers were interviewed. The writer sought to explore the reasons underlying their shipping decisions and what influence, if any, the freight tax played in their decisions.

Forty-eight large and thirty-four small companies selected from twenty-three industries in the Chicago area are represented in the primary data. The companies included were chosen because they seemed to offer the most value in a study of this kind. They all were in business from 1940-1957 and they had the option of using either private trucking or for-hire carriers for outgoing freight.

In the observation of the impact of the tax, four major questions are investigated. The first relates to the shifting and incidence of the tax. Due to the complex ramifications of this subject, it is difficult to reach positive conclusions. However, for both the short and long run, it appears that the consumer of the shipped products, for the most part, bore the tax ultimately, but in some cases, the tax rested upon producers, processors and carriers.

The second question is that of equity. Did the tax impose equality of treatment based on ability to pay? The conclusion indicates that the tax was inequitable because (1) in exempting private carriers, some consumers and firms escaped the burden of the tax, (2) the tax discriminated against long-haul and/or high cost freight, and (3) the tax discriminated against small shippers.

Third, the neutrality of the tax is considered. Did the tax cause a worsening of resource allocation? The analysis indicates that the tax restricted the amount of transportation services used. Also, available figures show that private trucking increased relative to for-hire services in this period, but the study concludes that the freight tax

was not the decisive factor in bringing about his increase. The companies surveyed reported that when cost factors entered into shipping decisions, the excise levy was at most only a minor consideration. The most important cost factors, they claimed, stemmed from the changing volume and structure of their sales. By structure of sales, they mean the degree of market concentration, availability of back haul, presence or lack of circle routes and steadiness of sales. These companies also reported that many noncost reasons impelled them to use private trucks. These included the need for (1) reliability or control, (2) special handling and equipment, (3) speed in delivery in order to meet competition, and (4) driver salesmen.

Thus, the tax was a negligible factor in the determination of the amount of private trucking. Even among large companies the data demonstrate that few companies acquired their own trucks or made additions to their trucking fleets in response to the tax. Also, there were no solid grounds for believing that companies purposely resorted to buy-and-sell operations. The traffic managers of the companies surveyed stated that such operations did not increase relatively in the years in which the tax was in effect.

Fourth, attention has been devoted to the difference between gross and net revenue from the tax. The net was less than gross because the tax reduced the income tax base and increased the cost of government purchases.

Microfilm $2.00; Xerox $6.20. 130 pages.

THE THEORY AND PRACTICE OF VALUE-ADDED TAXATION

(L. C. Card No. Mic 59-5298)

James August Papke, Ph.D.
Cornell University, 1959

Many state business taxes are levied with only vague references to the underlying theory. Further, there is currently no clear-cut conception of why and how the business enterprise should be taxed. All generally acknowledged is that state governments need revenue and that it is easy and convenient to collect large sums from business. The pressures of rising tax requirements, however, necessitate a reevaluation of the structure of state business taxation with the view to eliminating obvious inequities, or at least to minimizing the discriminatory or other detrimental effects.

The value-added tax, measured by the value of the contribution of the business enterprise to the output of economic goods in the state, is proposed as a possible foundation of state business taxation. Underlying such an impost is the recognition of the state government as a factor of production deserving of compensation in proportion to its contribution to the output of the business enterprise. It is advanced that this contribution can best be measured by relating the tax liability to the value added, which indicates directly the amount of economic resources employed by the business establishment.

For state governments, the value-added tax possesses several outstanding virtues. First, the levy is economically neutral, because it does not discriminate among firms with different types of organization or with varying amounts of factor inputs. Second, it is conceptually simple, readily complied with, and easily administered. Third, the yield from the value-added tax is relatively stable. And last, it is generally applicable at the origin of production, and, therefore, it capable of reaching all incomes arising within the boundaries of the taxing jurisdiction.

Variants of the value-added tax are currently in effect in two government units, the State of Michigan and the national government of France. Such a tax was also enacted in Japan in 1950, but never became operational, having twice been postponed and subsequently repealed. An empirical and theoretical analysis of the Michigan impost constitutes the main body of the study.

Since the adoption in 1953 by the Michigan legislature of the business activities tax, the variant of value-added taxation, the impost has proved successful in every respect. Currently, it is the largest single source of general fund revenues. But because the principle of value-added taxation has only been partially accepted and applied, the tax statute incorporates several discriminating features. Among the more prominent provisions requiring attention are the following: (1) the differential in tax rates between public utilities and other business firms, (2) the non-deductibility of depreciation on personal property, (3) the preference shown borrowed as opposed to equity capital, (4) the treatment of rental payments, (5) the minimum 50 per cent deduction of gross receipts, (6) the exemption of financial institutions, (7) the $10,000 exemption, and (8) the formula for the allocation of the tax bases of multi-state establishments. Taken in combination, these features vitiate much of what was gained by acceptance of the value-added principle of taxation, and, in addition, have significant repercussions on the amount of revenue collected. Alternative remedial measures are proposed and discussed.

The concluding chapters of the study are devoted to an empirical analysis of the relative impact of the business activities tax. In this endeavor, two methods are employed, the collections approach, and the representative sample approach. It was found that the tax is borne mainly by the large manufacturing corporations with value added exceeding $15 million. Examination of the representative sample revealed the not surprising fact that, for manufacturers at least, payrolls constitute the largest single measure of the tax. Further, because of itemized deductions, that industry seldom has recourse to the statutory provisions designed to equalize the tax impact.

Microfilm $5.40; Xerox $19.00. 423 pages.

CAPITAL REQUIREMENTS OF THE STEEL INDUSTRY, 1958 TO 1970

(L. C. Card No. Mic 59-3966)

Amnuay Viravan, Ph.D.
University of Michigan, 1959

The main objective of this study is to develop analytical methods for estimating total capital outlays for plant and equipment in the steel industry between 1958 and 1970. The two basic components of total capital outlays (expansion and replacement) are estimated separately in this investigation. The reason for separate estimates of each component is that the capital needs for expansion and replacement are largely independent.

The study commences with a review of the historical growth of the steel industry and a projection of annual steel ingot production and capacity to 1970. The projection of production is undertaken by an extrapolation of a regression line representing the historical relationship between real Gross National Product and annual steel ingot production. The magnitude of the statistical deviations from the regression line provide a measure of the safety margin required in the capacity expansion. The estimate shows that the steel industry will need to increase annual ingot capacity by approximately 45.8 million tons between 1958 and 1970.

The projected annual ingot capacity forms a basis for estimating corresponding capacity additions in coke ovens, blast furnaces and rolling mills. The interrelationship of these basic capacities is historically reviewed and projected in view of the technological change within the steel industry. When ingot capacity is used as a pivot upon which other capacities depend, the magnitudes of the net capacity additions in other basic facilities are ascertained from the prospective capacity relationships.

The concept of capital coefficients, which indicates the relationship between capital expenditures and capacity additions, is adopted in the analysis of capital requirement for expansion. Estimates are made of two capital coefficients applicable to the future net capacity expansion: the coefficient for new and completely integrated plants and the coefficient for non-new-plant expansion. For these estimates, an analysis is undertaken to measure the historical coefficients which are adjusted further for changes in price and the degree of integration. The derived coefficients per net ton of annual ingot capacity added are: 323 dollars for new-plant expansion and 190 dollars for non-new-plant expansion, both expressed in dollars of 1957 purchasing power. A further analysis indicates that approximately 20 per cent of the total net expansion will take the form of new plant. Combination of these estimates implies that the industry will need about 9.9 billion dollars of 1957 purchasing power to finance its net capacity expansion.

The capital requirement for replacement is estimated by the simulated plant balance method which makes use of data on the value of steel assets. This method reveals that the average useful life of steel assets is approximately 34 years and the life span is about 45 years. The life characteristics provide a basis for projecting value retirements of steel assets at original cost between 1958 and 1970. Further adjustments are made to these value retirements for changes in price and technology. The Engineering News Record Construction Cost index is used for this purpose. By this procedure, the capital needs for replacement are estimated to be 7.9 billion dollars of 1957 purchasing power.

Three general conclusions can be drawn from the study: (1) the concept of capital coefficients can be used to deal with the intricate capacity system of the steel industry and the projection of capital needs for expansion, (2) the simulated plant balance method is applicable to value data in the estimate of capital needs for replacement, and (3) the future growth of the steel industry will call for capital outlays of about 17.8 billion dollars of 1957 purchasing power, of which over 44 per cent will be attributable to replacement needs. Microfilm $2.75; Xerox $9.60. 212 pages.

ECONOMICS, HISTORY

ROBERT OWEN AND KARL POLANYI AS SOCIO-ECONOMIC CRITICS AND REFORMERS OF INDUSTRIAL CAPITALISM

(L. C. Card No. Mic 59-4307)

George Dalton, Ph.D.
University of Oregon, 1959

Adviser: Robert Campbell

The dissertation is concerned with two systems of critique and reform of market-organized industrial capitalism. One was contemporary with the early nineteenth century development of the system, and the other is a twentieth century, ex post analysis. Both share a common focal point, but differ essentially in analytical reference. The two systems of critique and reform are described in detail and then related to those recently experienced changes in structure and ideological norm in Anglo-America, characterized as Welfare State and New Deal policies of social control. The two critiques are also related to pre-industrial socio-economic systems of economic anthropologyand economic history.

The common focal point of Robert Owen and Karl Polanyi is what each regards as the divisive social and personal consequences of market-capitalist organization and material results. The reform measures advocated by each similarly are centered on superseding uncontrolled market economy by institution such social controls as would retain industrial mechanism, but subordinate its operation to what both regard as vital human and social needs. Each is concerned with making economic organization derivative from, and expressive of, social ties and ethical values.

The analytical reference of each is markedly different (although Polanyi is explicitly aware of the nature and import of Owen's system). Robert Owen (1771-1858) derives both his critique and reform systems from personal observation of, and participation in, the nascent market economy of early nineteenth century Great Britain. Owen delineates the effects of the new mechanized factory in its organizational setting of uncontrolled factory and output markets. He asserts that child factory labor, depression-created employment insecurity, the poor law system, extreme competition, and the institutionalized pursuit of material self-gain, result in indivudualism (lack of responsibility for others), materialism, and work alienation. Owen say the Industrial Revolution as radical social transformation, whose effects he described in terms of impact on values, attitudes, and behavior of working and owning classes.

The specific reform policies and movements of Owen, were his New Lanark factory and community, anti-depression measures, factory legislation, consumers' co-operation, agricultural villages of cooperation, trade unionism, and ethical religion. The essential nature of the social reformation he sought for industrial society is emphasized by considering the purposeful elements common to all his major policy schemes: the derivation of socio-economic organization which institutionalizes material security, education for character formation, and social communion. The latter is of special importance because it comprises the replacement of material self-gain with socially derived motive, as that which induces participation in economic activity.[1]

Karl Polanyi (1886----) is an economic historian whose work in three related spheres is considered. First, his analysis of those distinguishing characteristics of nineteenth century market capitalism, which, as organizing principles for the entire economy, were historically unique as well as determinative for social organization: self-regulating factor and output market operation, and material self-gain as institutionally enforced motive to participate in economic activity. (A subordinate theme is how micro-economic theory--empirically relevant to market organized economy--is derived from the formal meaning of economic). Secondly, Polanyi's work in economic anthropology and history show how the integrative patterns of reciprocity and redistribution functioned as dominant economic structure based upon socially defined obligation; further, how the operational devices of external trade and money are parts of these systems, but were instituted and functioned differently from their counterparts in market economy. (A subordinate theme is that only the substantive meaning of economy has relevance to the systems of reciprocity and redistribution). Lastly, Polanyi's analysis of the transition from laissez-faire market economy (as empirical organization and as ideological norm), and his policies of reform, are related to the reformist structures advocated by Owen, and to the non-market systems of reciprocity and redistribution.

Microfilm $5.60; Xerox $19.60. 437 pages.

1. The errors and inconsistencies in Owen's analyses, which are commented on throughout the paper, are summarized in the concluding chapter, as are also the main points of the paper.

ECONOMICS, THEORY

THE EFFECTS OF GENERAL CREDIT CONTROLS ON NONFARM RESIDENTIAL CONSTRUCTION

(L. C. Card No. Mic 59-4219)

Coldwell Daniel, III, Ph.D.
University of Virginia, 1959

From one short period to another, changes in nonfarm residential mortgage credit conditions have significant effects on the volume of nonfarm residential construction. But year to year variations in the direction or rate of change in nonfarm residential construction are dependent upon many other factors, of which income, population, tastes, liquid assets, and expectations seem to be important; and the effect of changes in any one of these variables may be, and has been offset by changes in one or more of the others.

The determination of the price, terms, and availability of nonfarm residential mortgage credit may be described in terms of the demand for and the supply of such credit. And, it may be said that the demand for nonfarm, residential mortgage credit is determined by, and varies directly with expenditures on nonfarm housing fees.

For the most part, the suppliers of nonfarm residential mortgage credit consist of financial institutions. Thus, the quantity of such credit supplied at a given price is determined by (1) the legal restraints on the portfolio practices of financial institutions, (2) the attitudes of financial institutions toward liquidity and solvency, and (3) decisions of financial institutions based on the yields of alternative investments. However, in considering the influence of general credit controls on the supply of nonfarm residential mortgage credit, it would seem appropriate to assume that the legal restraints on, and the solvency "requirements" of financial institutions remain constant.

The net effect of an increase in the relative yield on nonfarm residential mortgage credit is an increase in its supply; and the net effect of a decrease in the relative yield on nonfarm residential mortgage credit is a decrease in its supply. However, because of the "stability" of the yield on nonfarm residential mortgage credit, an increase in the relative yield on such credit is brought about by a fall in the yield on alternative investments; and a decrease in the relative yield on such credit is brought about by a rise in the yield on alternative investments. But the yield on alternative investments rises when general credit conditions are tight and falls when general credit conditions are easy. Thus, the net effect of tight general credit conditions is a decrease in the supply of nonfarm residential mortgage credit; and the net effect of easy credit conditions is an increase in the supply of nonfarm residential mortgage credit.

Of course, in practice, the effects of changes in other variables do not cancel out. Tight general credit conditions are associated with high or rising incomes. But increased savings are also associated with rising incomes. Moreover, during such times, the liquidity "requirements" of financial institutions decline. Thus, during tight general credit conditions, the supply of nonfarm residential mortgage credit, rather than decrease, may merely increase less than the supply of credit in general. It does not appear, however, that during contractions in general business, a decline in the flow of savings and an increase in the liquidity "requirements" of financial institutions offset the net effects of easy general credit conditions on the supply of nonfarm residential mortgage credit.

As incomes rise, expenditures on nonfarm housing fees tend to rise more rapidly than the supply of nonfarm residential mortgage credit. Consequently, nonfarm residential mortgage credit conditions become tight. Conversely, as incomes fall, expenditures on nonfarm housing fees tend to fall, resulting in an ease in nonfarm residential mortgage credit conditions.

Ultimately, changes in general credit conditions are traceable to the policies of the Federal Reserve System. Thus, general credit controls affect general credit conditions which, in turn, affect the volume of nonfarm residential construction.

Microfilm $2.80; Xerox $9.60. 214 pages.

ISSUES OF MODERN INTEREST DOCTRINES

(L. C. Card No. Mic 59-4616)

Arthur Merton Freedman, Ph.D.
University of Pennsylvania, 1959

Supervisor: Sidney Weintraub

This study seeks (1) to clarify relationships between stock and flow analyses in interest theory, (2) to assess the validity of alternative doctrines, (3) to distinguish influences on interest in various stages of temporal adjustment, and (4) to incorporate liquidity and interest phenomena within a framework encompassing asset preferences in general.

Included are the following: an outline of stock and flow analyses and their bearing on the interest problem; an exposition of principal modern doctrines, including the simple liquidity preference, the loanable funds, and the "Neo-Keynesian," in which interest depends on relationships within an aggregate structure linking the production function, labor supply, saving and investment relations, the amount of money and other assets, and the structure of asset demands; an evaluation of issues basic to monetary theories in general, including the roles of money, uncertainty, and wage-flexibility conditions; an appraisal of the loanable funds and Neo-Keynesian doctrines; and an explanation of money demand and interest in the context of a general theory of asset prices.

In this presentation momentary asset prices depend on (1) the legacy of asset stocks and their distribution, (2) expectations of future returns and sales values, (3) preferences with respect to mean gain and risk. The price structure affects the profitability of producing new asset goods, in turn influencing income, household net worths, the structure of asset stocks, and, via induced changes in productivity, expectations -- interacting on the asset-price structure over time.

Conclusions include the following:

1. Interest is found subject to monetary influences in various stages of temporal adjustment. At a moment, changes are traced through substitution and wealth effects. In the short-period, with or without wage-price flexibility or interest-elastic saving and investment functions, money and liquidity preference are shown to influence not only prices and money income, but the rate of interest as well. Under conditions of growth, with significant additions to stocks of real assets and claims, increasing the supply of real money balances by reducing prices is shown to be an imperfect substitute for an increase in nominal balances, providing scope for persistent monetary influences on interest rates over longer periods.

2. The loanable funds approach, as flow-oriented, is shown to be inferior to, and to differ significantly from, stock-oriented theories. In addition the loanable funds analysis is limited by the following: (1) as a partial equilibrium approach, it omits strategic variables; (2) as an analysis of temporary equilibrium, it lacks integration with longer-term forces; (3) it invites difficulties in explanation of a structure of rates; and (4) by embracing uniform and synchronous payment periods, it limits effective application.

3. Among stock-oriented theories, differences between liquidity preference and bond preference theories are shown to involve a terminological issue as to which yields shall be included in the interest concept, rather than divergent explanations of common phenomena. This issue is resolved when the theoretical framework is broadened to encompass asset-price determination in general.

4. The developed asset-price approach discloses the following advantages: (1) it clarifies perspective with respect to adjustments over time, disclosing short-period equilibrium as transitional for interest theory; (2) it illuminates complexities of asset choices neglected by the liquidity preference approach; (3) it incorporates direct substitution and wealth effects overlooked in two-asset models; (4) it clarifies differences between the temporary equilibria to the loanable funds and stock approaches; and (5) it integrates influences of money and uncertainty as well as the traditional forces of productivity and thrift.

Microfilm $2.25; Xerox $8.00. 172 pages.

STUDIES IN THE PURE THEORY OF CAPITAL

(L. C. Card No. Mic 59-4314)

Thomas Iwand, Ph.D.
University of Oregon, 1959

Adviser: Richard M. Davis

The purpose of our study is to present a simple and consistent theory of capital accumulation. We demonstrate that as long as the assumption is made that the entrepreneur maximizes his profit over time, conditions for the optimum allocation of resources and the value of any production process can be stated explicitly. A number of mathematical models are developed to deal with different types of production processes in which inputs and/or outputs proceed over time.

The problem of aggregation is solved in two ways. The first solution presents a simple traditional model of capital accumulation of the Wicksell type which differs from the investment theory of the firm merely in the scale of its parameters. It can be shown that this model is based on the assumption that static equilibrium conditions prevail. The second model, which resembles closely the theory of Irving Fisher, has a more general applicability. Here a time path of capital accumulation can be deduced from postulated production and time preference schedules.

The value of a single production process and the value of the aggregate stock of capital are determined with the postulate of period foresight. Although there appears to be no simple alternative postulate on which a theory of capital can be based, this assumption is highly artificial. The second part of our study deals critically with some attempts to construct theories of capital accumulation which avoid the assumption of perfect foresight.

If a rigid production function is postulated, as in Marxian models of expanded reproduction, the conditions for an optimum allocation of resources over time follow directly from the technical properties of the production process. It is demonstrated, however, that the conclusions of such a system, which would imply the imminent danger of a complete breakdown of the economic system, are unrealistic. Any attempt to modify the theory so as to enhance its operational significance requires the substitution

of basically neo-classical assumptions for those of the traditional Marxian theory.

Similarly, a model of capital accumulation may be based on the postulate of a constant capital-output ratio, as in the more modern accelerator models. The simple Harrod-Domar model does not differ in its conclusions from the Marxian model of expanded reproduction. It does not account for income fluctuation but merely for a complete breakdown of the system. The Hicks-Goodwin cycle model, which avoids the extreme conclusions of the non-lagged theory, is rejected as a theoretically indeterminate system. Although it is possible to modify the multiplier-accelerator model so as to avoid the extreme conclusions of the simpler models, such a theory is unnecessarily complicated. The same conclusions can be deduced from a slightly modified neo-classical model.

It appears that the neo-Marxian and neo-Keynesian growth models which avoid technically the assumption of perfect foresight and given preference scales render unrealistic conclusions. Any modification of these models which would enhance their applicability requires the substitution of a production function characterized by some degree of substitutability for those postulated by either system.

As long as the assumption of perfect foresight and given preference scales can be made, the capital model presented in the first part of this study can be applied without difficulties. Any useful extension of the neo-classical model must attack the problem of uncertainty. No attempt to avoid it by postulating still more stringent patterns of expectations bears any hope of success.

Microfilm $2.45; Xerox $8.40. 185 pages.

THE EMPLOYMENT EFFECT OF MINIMUM WAGE REGULATION IN THE SOUTHERN PINE LUMBER INDUSTRY

(L. C. Card No. Mic 59-4035)

Charles Phillip Sawaya, Ph.D.
Indiana University, 1959

Supervisor: Professor Carroll Lawrence Christenson

This dissertation attempts to determine whether the experience of federal minimum wage regulation in the southern pine lumber industry over the past two decades can be explained by a hypothesis consistent with the traditional microeconomic employment theory.

Southern pine lumber has been singled out for this task for three major reasons: first, because of it's "low-wage" structure the industry has been one of the most directly affected by the F.L.S.A.; second, on a number of occasions it has displayed apparent incongruities with the traditional microeconomic employment theory; and finally, a large body of data permits critical examination.

The apparent incongruities between the predictions of the traditional theory and the actual behavior of a number of "low-wage" industries under federal minimum wage regulation have lead some economists to the conclusion that the productivity theory of wages and employment is invalid. In view of the fact that no comprehensive analysis of the important economic variables, other than wage rates and employment, has been made in the relevant industries, this conclusion appeared too hastily drawn.

Therefore, with the aim of shedding further light on the question of the possible invalidity of the traditional microeconomic employment theory, as much data as was available bearing on the wage and employment relationship in southern pine lumber was collected. The major hypothesis tested was that a synthesis of dynamic expansion in the economy, and internal cost and structural adjustment in the southern pine lumber industry may have offset the classically predicted shortrun employment effects of "forced" wage increases.

The findings of the dissertation strongly substantiated the hypothesis, and have lead to the belief that the minimum wage experience of the southern pine lumber industry is not at odds with the productivity theory of wage determination. Firms which have been able to meet the federal minimum wage requirements without reducing employment are also those which have been most easily and thoroughly surveyed by the Bureau of Labor Statistics. Moreover certain structural changes have insulated large numbers of producers from conformity with the federal law, and there has also been some evasion. In the longrun, structural readjustment encouraged by the F.L.S.A., and higher wage payments brought on principally by the drainage of rural labor out of the South, with only slight influence from the federal minimum wage requirement, have lead to a marked reduction in employment and production in the industry. Finally, evidence collected indicates that natural elements without legislation would have produced most of the actual wage increases that occurred in the industry between 1938 and 1957.

Microfilm $5.10; Xerox $17.00. 400 pages.

EDUCATION, GENERAL

CERTAIN CHARACTERISTICS OF THE FRESHMAN CLASS ENTERING LAMAR STATE COLLEGE OF TECHNOLOGY, 1957-1958

(L. C. Card No. Mic 59-4363)

Howard Wesley Adams, Ed.D.
The University of Nebraska Teachers College, 1959

Adviser: Dr. J. Galen Saylor

The purpose of the study was to describe the Lamar freshman class, 1957-1958; to indicate their persistence and success in college; to analyze factors associated with that persistence and success; and to compare that freshman class with other freshman classes.

A questionnaire was developed in order to obtain information about the students and their families. This information was obtained at the freshman orientation period. Intelligence and achievement test scores for the students were obtained from the Otis Self-Scoring Intelligence Test, the Cooperative Mathematics Test and the Cooperative English Test. The information concerning the high school record was obtained from the high school transcripts which were submitted to the college with the student's application for admission to college. Data involving college registration, achievement, and persistence of the freshmen were obtained from the files in the office of the registrar. College sponsors of organizations, department chairmen, and deans of students were interviewed to gain information about the non-credit activities of freshmen.

The data received from the questionnaires were tabulated and recorded. The significance of each factor in relation to persistence and success in college was determined by the application of chi-square to that information.

Findings resulting from the study are:

1. The majority of Lamar freshmen are from the immediate area surrounding Lamar, which is an industrial and business center of the state.
2. The families of the students are primarily of lower-middle economic status and average in most other respects.
3. The personal characteristics of the Lamar freshmen reflect average age, more men than women, regular in church attendance, predominantly of the white race, graduates of public high schools, some past work experiences, dependence on parents for some support financially, active in extra curricular activities in high school and active participation in leisure activities.
4. If ranking at the 50.0 percentile is accepted as normal achievement for college freshmen on the Cooperative English Test, then Lamar students rank significantly lower in the area of English mastery. The other test scores did not reveal significant differences from a normal group.
5. There were statistically significant differences when comparing those students who withdrew from college with those who did not. Freshmen from large high schools and scholarship students remained in college in significantly larger numbers.
6. Freshmen who graduated from large, public high schools, those whose parents came from a higher occupational classification on the Sims scale, students who planned to remain in college for four years, had worked some prior to college entrance, and who listed the sciences as the most liked subject area revealed significant differences in successfully continuing at Lamar.
7. Students from small and non-public high schools, students irregular in church attendance, males, freshmen 19 years and older and of a race other than white showed significant differences in unsuccessful achievement while in college.
8. When comparing freshmen at Lamar with freshmen of other colleges, the differences tended to be those based on geography, economy of the area, age and type of college, and factors of a local nature.

Microfilm $2.15; Xerox $7.60. 162 pages.

A CRITICAL ANALYSIS OF THE MUSIC PROGRAMS IN THIRTEEN SELECTED TEXAS PUBLIC JUNIOR COLLEGES

(L. C. Card No. Mic 59-4713)

Robert Alvin Campbell, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Clyde C. Colvert

The purpose of this study was to investigate the overall music programs of thirteen selected Texas public junior colleges and to evaluate the respective programs according to the judgments of a board of experts.

Data necessary for this study were obtained through five main sources: (1) responses to a questionnaire by the music department heads or logical alternatives of the thirteen junior colleges; (2) the study of catalogs and other publications; (3) personal visits to some of the colleges and personal contacts with representatives of most of the colleges; (4) official information reported by the Texas Education Agency, the Texas Commission on Higher Education, and the Extension Division of the University of Texas; and (5) responses to a checklist by nineteen individuals particularly well qualified in the area of junior college music (the board of experts).

The present status with regard to the music programs of the thirteen junior colleges and the desirable status as recommended by the experts were sought for the following general items: purposes of the music program; general

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

organization; the music department heads; the institutional staff; student personnel; finance; housing and facilities; counseling and guidance; music in the summer school program; promotion and public relations, general breakdown of the music curriculum; applied music study, performance groups; service to the general college student (non-music major); and community service.

The findings of the study indicated that the present status for the thirteen junior colleges and the desirable status in the opinion of the experts were in agreement with regard to most of the specific factors investigated. Major points of disagreement were found with regard to the following factors.

1. General organization of the music program.
2. Number of clock hours of applied music lessons per week considered a full teacher load.
3. Average music class size, excluding ensembles and private lessons.
4. Required use of practice records by students of applied music.
5. Number of hours of band rehearsal per week.
6. General function of the band.
7. Collaboration with the community in promoting concert series of professional artists.
8. Sponsorship (independently or in conjunction with the community and/or the public schools) of junior string projects.
9. Evening music classes.
10. Participation of local townspeople not enrolled as students in performance groups.

It was noted that four of the ten major points of disagreement were in the general area of community service.

Microfilm $3.50; Xerox $12.00. 271 pages.

AMERICAN EDUCATIONAL SOCIOLOGY FROM 1890 TO 1950--A SOCIOLOGICAL ANALYSIS

(L. C. Card No. Mic 59-3687)

Brigham Young Card, Ph.D.
Stanford University, 1959

This research examines the origins and development of educational sociology as a socio-cultural phenomenon in the United States. It is designed in such a way that studies of the discipline's diffusion from the United States to other cultures may be facilitated. From the perspectives of collective behavior and institutions four indexes are selected for analysing educational sociology in cultural context: the socio-cultural base, personnel, ideologies, and patterns of interaction. The relationships of the discipline as a whole and as separate elements are examined in relation to American culture as it changes in time by means of hypotheses derived from invention and diffusion theory. Data were obtained predominantly from documents, to a limited extent from interviews.

After an introduction stating the theoretical basis of study an analysis is made of the inventing of educational sociology between 1890 and 1910. It is found that the elements synthesized into educational sociology were predominantly products of American culture during these two decades, though antecedents of these elements are found in earlier America and Europe. Success of initial inventing effort was signalled in 1910 by establishment of an educational sociology course at Teachers College, Columbia University. Four decades of diffusion and continuing invention followed.

Analysis of the discipline's personnel from 1910 to 1950 discloses that they were always comparatively few in relation to the potential numbers of leaders and members available in American education and sociology. Further, the discipline's leaders tended to be identified with education more than sociology, trained in education more than sociology, and marginal with respect to roles and statuses in both fields.

Ideological analysis reveals five distinct conceptions of educational sociology (or its functional equivalent). These are: a social philosophy of education, sociology applied to the problems of education, sociological study of the total social background in which education is conducted, strict sociological study of educational institutions and processes, and synthesis of all social scientific knowledge into a special discipline for educators. Ideologies of the discipline's conventional elements--courses, textbooks, periodicals, research, associations and personnel--reflect the diverse conceptions of the field, the changing focuses of interest in American education and sociology, and American social problems generally.

Patterns of interaction are predominantly institutionalized forms adopted from American higher education and professional associations. However, a considerable proportion of the interaction significant in invention and diffusion of the discipline did not take place in institutionalized patterns. Non-institutionalized interaction frequently took the form of competition, conflict and accommodation, and in its larger dimensions, a social movement. As a social movement, the main stream of educational sociology, with many of its goals still unachieved, became stalemated in the 1930's before full institutionalization.

Under dislocations of Depression and War educational sociology, as an invention to produce and disseminate sociological knowledge about education, was modified in the direction of an invention to stimulate social action on behalf of American democracy. In the late 1940's continuing invention was signalled by (1) agitation to replace or supplement existing educational sociology with a scientific sociology of education and (2), appearance of the social foundations movement to create for educators a new discipline synthesized from all the social sciences. At mid-century American educational sociology appeared as a collection of unfinished inventions designed to achieve relatively similar ends.

The study is concluded by a generalized view of the invention and diffusion of educational sociology in a dynamic American culture. This provides a basis for formulating hypotheses about the diffusion potential of educational sociology for other cultures from 1890 to 1950. Suggestions are made for further study of American educational sociology and for the study of the discipline (or its equivalent) in other cultures.

Microfilm $6.40; Xerox $22.20. 501 pages.

A STUDY OF SCHOLASTIC ACCOMPLISHMENT IN SECONDARY LANGUAGE ARTS IN RELATION TO PUPILS' RELATIVE SUBJECT PREFERENCE FOR THAT AREA OF STUDY

(L. C. Card No. Mic 59-4443)

Kenneth Vincent Curry, Ed.D.
University of Pittsburgh, 1959

The hypothesis tested by this thesis was "Accomplishment in the Language Arts will vary in accordance with the variation in mental ability but accomplishment at any given level of mental ability will vary in accordance with the expressed relative subject preference for language." Subproblems examined were: Does relative subject preference for language exist as a separate variable from mental ability in relation to accomplishment in language? What is the relationship of years of study in language to mental ability, relative subject preference for language and language accomplishment? What relationships exist between sex and the above variables?

Measures of mental ability, relative subject preference for language, and of language accomplishment were administered to 863 seniors in three high schools suburban to Pittsburgh. All measures except that for relative subject preference were published standardized tests. The measure for relative subject preference was newly devised by the group working in the area of relative subject preference.

To the data collected from the above sources, various statistical tests were applied. Correlation coefficients and correlations with partialling were determined for relationships between (1) mental ability and accomplishment in language, (2) relative subject preference for language and accomplishment in language, and (3) mental ability and relative subject preference for language. As a result of such correlations, substantiation was given to the assumption that mental ability and relative subject preference for language were separate and distinct variables in relation to accomplishment in language. Support was also given to the assumption that relative subject preference for language was an intervening variable at any given level of mental ability in relation to accomplishment.

Analysis of variance was used to determine the relationship of years of study to the variables: mental ability, relative subject preference for language, and accomplishment. The significance led to the following conclusions for the sample population: (1) that the election of more years of study has a positive relationship with increased mean mental ability as measured by a verbal intelligence test, (2) that those who freely elect to study language for more years have the higher relative subject preference for language, and (3) that those who elect more years of study in language do have the higher accomplishment in language.

Sex was also found to possess a significant relationship with relative subject preference for language and with accomplishment in language. The discovery of this relationship was the result of determining the significance of the differences of means of relative subject preference for language and of accomplishment in language for boys and girls in two subgroups chosen from the sample population. The two groups were: (1) those with one-half year or less of study in foreign language, and (2) those with three years or more of study in foreign language. The mean mental ability of the boys and girls in each group was found to be relatively the same. The differences in means for relative subject preference for language and for accomplishment in language was found to be significant in each case and resulted in the following conclusions: (1) that girls express a higher relative subject preference for language, and (2) that girls do, on the average, accomplish to a greater extent in language than do boys who have, on the average, the same mental ability.

The findings for this study are found at the end of each paragraph summarizing the results of statistical devices applied to the data collected from the sample population used in the study.

Microfilm $2.00; Xerox $5.20. 105 pages.

THE RELATIONSHIP BETWEEN LISTENING ABILITY AND SHORTHAND ACHIEVEMENT

(L. C. Card No. Mic 59-4444)

Charles Howard Duncan, Ed.D.
University of Pittsburgh, 1959

For years, business education teachers have been concerned about the comparative lack of achievement on the part of students enrolled in shorthand courses. While researchers have attempted to rectify this situation by seeking factors which would contribute to better guidance and instructional methodology, no single factor which could be used remedially or prognostically has yet been found.

Although listening ability might be considered one such single factor, difficult if not impossible to isolate, it is assumed by many to be in reality a composite of various physical and mental elements. Furthermore, it has been shown to have a positive relationship with general scholastic achievement. This study, therefore, proposed to measure the listening ability of high school students studying Gregg shorthand, in order to determine to what degree that ability appears to be a consistent factor with achievement in shorthand.

The Brown-Carlsen Listening Comprehension Test, Form Am (Yonkers-on-Hudson, New York: World Book Company) was the instrument chosen for measuring listening ability. This examination is composed of five subtests: Immediate Recall, Ability to Follow Directions, Ability to Recognize Transitions, Ability to Recognize Word Meanings, and Lecture Comprehension. A second test used was the Syllable Enumeration Test, constructed for this research, which measures the ability to enumerate syllables heard in words dictated orally. Shorthand achievement was measured through a 300-word test consisting of 3 letters dictated at speeds of 90, 100, and 110 words a minute. This test was also constructed by the writer.

These three tests were administered by tape recording to 552 third-semester shorthand students in nine western Pennsylvania high schools. Ninety-three students were rejected from the study because of incomplete scores or because their health record indicated that they possessed other than normal hearing.

The remaining scores were arrayed according to school source and as an amalgamated research population. Coefficients of correlation for these populations were calculated between the shorthand-achievement scores and scores

for each of the following: (1) the Brown-Carlsen Listening Comprehension Test as a single unit; (2) the Immediate Recall subtest; (3) the Ability to Follow Directions subtest; (4) the Ability to Recognize Transitions subtest; (5) the Ability to Recognize Word Meanings subtest; (6) the Lecture Comprehension subtest; and (7) the Syllable Enumeration Test. Included as items of interest are comparisons between mean scores of students accepted and students rejected because of hearing status and between percentile ranks for "face-to-face" and tape-recorded administrations of the Brown-Carlsen Listening Comprehension Test.

The coefficients of correlation obtained appear to support a conclusion that a relationship between listening ability and achievement in shorthand does in reality exist, but it tends to be slight. The most substantial coefficient calculated for the total research population was .36, found when the scores on the shorthand-dictation test were correlated with the total scores on the Brown-Carlsen Listening Comprehension Test. While all other correlations obtained with the total research population figures were positive, they ranked below .36, ranging from .17 to .28. The coefficients found for correlations involving the high school populations ranged from -.07 to .63.

Microfilm $2.00; Xerox $5.40. 108 pages.

FAMILY AND FAMILY LIFE CHANGES AND THEIR IMPLICATIONS FOR ELEMENTARY EDUCATION

(L. C. Card No. Mic 59-4758)

Billy Van Freeman, Ed.D.
The University of Texas, 1959

Supervisor: Dr. Henry J. Otto

Family changes and their importance in our society today are discussed by authors in the field of education as well as in sociology, but the implications for elementary education are dealt with very little or not at all.

The problem of this study was two-fold: (1) to identify, clarify, and describe in realistic terms family and family life changes which have implications for elementary education, and (2) to draw out or "spell out" these implications as much as possible.

The data for this study were obtained in the following manner: (1) Information from twelve recognized authorities in the field of sociology was used as the basis for selecting seven important family changes--the changing role and function of family members, increased tension in family living, change in family size and composition, higher standard of living, increased mobility and world-mindedness, increased urbanization, and change in value patterns; (2) the next step consisted of a thorough investigation from the field of sociology concerning these seven changes, using literature by the twelve sociologists and other available sources from the field of sociology in step one. From these sources implications for elementary education as stated by sociologists were obtained; (3) additional implications for elementary education regarding the seven family changes were found in the literature from the field of elementary education. The last chapter of this study gives a summarized picture of the significant findings from the two fields of sociology and education.

The important implications for elementary education as stated by sociologists and educators are: (1) The school has greater responsibility in the area of character and moral development; (2) school directed activities need to be expanded in order to take up more of the children's time; (3) the purpose of the school needs to be clarified; (4) children should be prepared for changes; (5) schools have a new responsibility to train children to be global neighbors; (6) there is a greater need for economic education; (7) the meaning of work to the individual himself, to his family, and to his dependents should be stressed in the classroom; (8) there need to be organized programs for teaching the proper use of leisure time; (9) more than textbooks are needed in order to keep pace with the fast moving events of family living; (10) more consideration needs to be given to the contributions children may make to families; (11) smaller classes are needed to meet the new demands on education; (12) there is a need for skilled counselors to assist teachers; (13) much of the job of child training has been shifted to the teacher, causing her to have an increasingly difficult and time-consuming task; (14) suburban schools are likely to be well supported by parents which gives school personnel opportunities to obtain needed improvements; (15) parents have stronger convictions regarding the potentialities of the school to influence their children's development; (16) more importance should be placed on effective school-home relations; (17) education should be recognized as a life-long process to which all social institutions should make their contributions; (18) children should be encouraged to use their creative abilities in school; (19) because of the increased complexity of individual differences, teachers have a more difficult job of getting desired results from their various teaching methods; (20) if both parents work outside the home, the tendency is that there is little motivation at home for children to do good work in school; (21) more instruction concerning proper diet is needed; (22) there is a greater need for children to have contact with male members of society; and (23) pupils need information about their fathers' occupational roles.

Microfilm $4.45; Xerox $14.80. 345 pages.

THE ACCULTURATION OF MIDDLE EASTERN ARAB STUDENTS IN SELECTED AMERICAN COLLEGES AND UNIVERSITIES

(L. C. Card No. Mic 59-3701)

Khalil Ismail Gezi, Ph.D.
Stanford University, 1959

The Problem

The present research was attempted to survey and analyze the adjustment problems of sixty-two Arab students in certain California colleges and universities, and to explore and test specifically the association between adjustment to American culture and each of the following variables: pre-arrival acculturation, pre-arrival favorability toward the United States, age, sex, academic program, marital status, type of college, duration of sojourn, national status and success in college. This research has also attempted to point out the implication of its findings to the Middle Eastern and American educational authorities who are interested in sound student exchange programs.

Methodology

Two open-end interview schedules were developed. The first, which contained twenty questions, was used with each student in the sample. The second, which consisted of five questions, was used with certain faculty members and foreign student advisers selected from the institutions in which most students in the sample were studying.

Based mainly on the students' and the faculty responses to these interview schedules, as analyzed by the investigator and an independent rater, the adjustment of each Arab student to American culture was determined. Adjustment was defined as the expressed satisfaction of the student with his sojourn in the United States. Three ratings of satisfaction were made: (1) from the expressed opinions of each student, (2) from the opinions of each student regarding the satisfaction of other fellow students, and (3) from the opinions of certain faculty advisers of the students.

When satisfaction was determined and the data were classified into categories describing each of the variables mentioned before, the association between each variable and satisfaction was tested by using the chi square analysis of independence.

Results

1. Forty-five out of the 62 Arab students studied apparently were satisfied with their sojourn in the United States.

2. Satisfaction with the sojourn was found to be associated with (a) pre-arrival acculturation ($P < .01$); (b) pre-arrival favorability ($P < .001$); (c) age ($P < .01$); (d) academic program ($P < .02$); (e) duration of sojourn ($P < .10$); (f) accorded national status versus subjective status ($P < .001$); and (g) success in college ($P < .001$). These associations were found to be consistent with certain hypotheses which this study has advanced.

3. The responses of the students indicated that the major adjustment problems were in the following areas: (a) social; (b) economic; (c) academic; (d) linguistic; and (e) personal.

Conclusions and Recommendations

1. The following were the recommendations made to the Middle Eastern authorities: (a) better placing of Arab students in American colleges; (b) using comprehensive assessment measures in selecting students to come to the United States; (c) offering orientation programs and seminars on American life and customs to all selected students before departure; (d) facilitating dollar exchange to students; (e) informing the Arab students in the United States about events in the Middle East; and (f) helping the student returnees find suitable jobs.

2. The following were the recommendations made to American colleges and universities: (a) sending Arab applicants prompt information on requirements, courses of study and community life; (b) receiving the new Arab student upon arrival and giving him individual help during the first few days of his sojourn; (c) using an individual approach in the orientation programs for new Arab students; (d) providing activities in which the Arab students can use their talents and backgrounds; and (e) providing meaningful interaction-potential situations for Arab students in the college and in its community in order to foster a mutual good-will through international understanding.

Microfilm $3.35; Xerox $11.40. 260 pages.

AN ANALYSIS OF CONSERVATION EDUCATION IN CURRICULUMS FOR GRADES KINDERGARTEN THROUGH TWELVE

(L. C. Card No. Mic 59-3521)

Elizabeth B. Hone, Ed.D.
University of Southern California, 1959

Chairman: Professor Perry

It was the purpose of this study to investigate some of the causes of discrepancy between American thought and practice with regard to conservation education. It was proposed to study the problem through an analysis of the printed curriculums of the public schools and the texts and tests used in conservation education. It was the specific purpose of this study to make a nation-wide inventory and analysis of conservation in school curriculums from kindergarten through the twelfth grade.

Curriculums were solicited from state education departments, departments of conservation, and from the 106 largest cities in the United States. Some materials from counties, teacher workshops, and private groups were used.

The data from these curriculums and materials were tabulated according to categories which emerged as the most commonly used concepts of conservation. These categories were as follows: renewable resources, such as soil, water, plant and animal life; nonrenewable resources, such as metals, minerals, fossil fuels; human resources, such as health, safety, recreation, community resources, guidance.

The curriculum analysis revealed that more conservation material came from state than city school sources; that the states published general, whereas the cities published more specific curriclum suggestions. There was, in general, consistency between the aims, content, and method of school and nonschool conservation education material. Conservation education was taught most frequently in grades six through nine. Most of the publications specifically for elementary or secondary schools came from school sources; nonspecific publications from nonschool sources. The format and extent of this sampling of the curriculums showed that the per cent amount of published curriculum space devoted to conservation education was relatively small. Conservation was seldom recommended as a separate subject. Conservation was found to be associated nearly twice as often with science as with social studies. Conservation education was found most frequently associated with science at the elementary level and with social studies at high school levels. Conservation education as indicated by the curriculum analysis was regarded by school people mainly as a renewable resource problem.

After the analysis of the curriculums had been made, it was thought advisable to verify the evidence by submitting the findings to a jury of experts. The jury was asked to

respond to a questionnaire of items which paralleled the main categories and groups of data obtained in the analysis of the curriculums.

The experts corroborated the findings of the curriculum study in seven out of the twelve areas covered by the questionnaire. Although there was some slight disagreement in five of the areas, the experts on the whole were in agreement with the findings of the curriculum analysis.

An analysis of some science texts and conservation tests was undertaken to see if the direction of conservation education as expressed in the printed curriculums of the public schools was carried out in the content and evaluation practices used. This analysis showed that the emphasis on conservation in the elementary science texts was on renewable resources. The tests were designed to test knowledge of facts concerned mainly with renewable resource conservation.

The study indicated that, although educators usually define conservation as the wise use of natural and human resources, the emphasis in most curriculums, in the minds of most experts in conservation education and in most elementary science textbooks, is on renewable resources.

Implications and Recommendations. The study showed the need for redefining concepts of conservation in terms of the needs of modern society. If today's resource problems involve more than renewable resource problems, then there is need for our curriculums to reflect such shift of emphasis. The present emphasis and methods of teaching conservation as reflected in much of the material examined appear to have little relationship to the resource problems of a modern industralized society.

Microfilm $2.00; Xerox $7.00. 146 pages.

CAUSAL FACTORS OF DROP-OUTS FROM UPPER SIX GRADES IN SELECTED FOURTH CLASS SCHOOL DISTRICTS IN McKEAN COUNTY, PENNSYLVANIA

(L. C. Card No. Mic 59-5111)

William David Igoe, Ed.D.
The Pennsylvania State University, 1959

Statement of the problem. This study was designed to determine what factors cause pupils to leave high school before graduation and to classify these factors according to their origin and responsibility. In addition, data were presented answering questions evolving from the statement of nineteen subordinate problems.

Procedure used. The study was made in a rural, nonfarm, sparsely populated area. In order to secure an adequate sample, two high schools with contiguous attendance service areas were included in the study. Pupils who entered seventh grade in 1948, 1949, 1950 or 1951, and who should have graduated in the class of 1954, 1955, 1956 or 1957 were studied. The progress of 768 pupils was recorded as they advanced through secondary school until they graduated, transferred or left school as drop-outs.

Since the study was one of depth rather than breadth, few comparisons between drop-outs and graduates were made. Causes, not comparisons, were of primary concern.

Data were secured during a personal interview with each of the eighty-seven drop-outs, using a check list developed by the investigator. Using another form of an original check list, additional data for the same drop-outs were collected by careful examination of all available school records, both elementary and secondary, and by a study of factors related to the family and home environment.

Chapter IV of the completed study contains these data in tabular form; Chapter V presents an interpretation of the findings and their implications.

Conclusions and Recommendations. McKean County drop-outs listed reasons relating to school most frequently as reasons for leaving school early. Reasons of a personal nature were listed almost as frequently as those related to the school but economic need and factors relating to the home appeared to exert little influence.

A profile of the typical McKean County drop-out showed him to be not unlike those reported by earlier researchers. Early school leaving appeared to be symptomatic among families; grade failure and retardation in elementary school, subject failure in the junior and senior high school, and regression in number of days attended appeared to be symptoms of vulnerability.

Based on the results of this study, the following recommendations were made:

1. School officials, including the board of education, faculty and administration, must more carefully evaluate the educational program in the elementary school.
2. Each child must be studied as an individual. This implies better rapport between the home and the school so that parents may cooperate in the evaluation of the child's mental, physical and social growth.
3. This study indicates a need for careful revision of the curriculum and a critical evaluation of courses of study in English and social studies.
4. The co-curricular program must be examined with an intention of broadening its scope in an effort to encourage a larger number of pupils to participate.
5. School records must be kept up-to-date, complete and accurate. A cumulative record folder, begun the day the child enters the school, should follow him from grade to grade, and from school to school, and should be available for all teachers to study.
6. Each school should employ a full time guidance counselor. This counselor should be responsible for counseling, testing, aiding pupils in selecting curricula and courses of study, developing better home-school relationships, keeping cumulative school records complete, accurate and up to date, providing class instruction in a study of job opportunities and occupational information.

The investigator concludes that no single causal factor can be discerned. Instead, a group of factors appears to be at work. It is his contention that the drop-out problem is a complex and intricate one which must be solved locally with the cooperation of all agencies interested in the welfare of youth. Microfilm $2.00; Xerox $6.60. 139 pages.

SELECTED GENERAL EDUCATION OUTCOMES OF A FOREIGN TRAVEL AND STUDY PROGRAM

(L. C. Card No. Mic 59-5115)

Elizabeth Waugh Leonard, Ed.D.
The Pennsylvania State University, 1959

This study was undertaken with several purposes in mind: (1) to review the foreign travel and study program at Adelphi College; (2) to find out what methods of evaluation had been used by scholars in determining the effects of foreign travel and study; (3) to apply those methods of evaluation which were suitable, as well as devising additional ways, for evaluating foreign travel and study. The principal method used in this study consists of before-and-after measurements of attitudes, opinions, general and specific knowledge, and language facility of American College students from the Metropolitan New York area who went abroad during the summer and fall of 1957. Pertinent subjective data are also presented.

Subjects in the study for whom both before-and-after data as well as subjective data were obtained consisted of 14 students who had completed their junior year of college, and who were preparing to teach. Their goals, to be achieved through foreign travel and study, and those of their instructor were ascertained and integrated.

Attitude and opinion scales used were the C-R Opinionaire (published by the Character Research Association of Washington University, St. Louis, Mo.), the Dimensions Scale used by Hilda Taba, the Study of Values by Allport-Vernon, and the Ethnocentrism, Fascism and Political-Economic Conservatism Scales from Adorno. Other tests consisted of questions from the Inventory of American Orientation from Syracuse University's Maxwell Graduate School, and devised by the Author, a General Knowledge test, Free-hand and Outline map tests and language questionnaires. Subjective data consisted of statements made by the students in their essays, diaries, written evaluations, progress reports, notebooks and other assignments.

The principal findings and implications of the study are the following:

1. The students as a group were slightly less conservative after the trip abroad in that they strove more for new values rather than conserving old values; in other words, a general liberalizing of attitudes was evident.
2. The students as a group retained their stereotype of the "ideal" national culture, slightly changed their opinion of their own country (U.S.), and realigned their views of a foreign culture (France) after they returned from abroad. In general, the characteristics they assigned to European countries (England, France, Germany and Italy) indicated greater understanding and less prejudice.
3. The students had slight knowledge of the geography of Europe before embarking for Europe. After traveling abroad, all the students demonstrated gains in their knowledge of Europe. These gains were not the result of formal study.
4. Students who attended a foreign-language-speaking university improved their understanding and skill in that language. Although gains were not noted by the faculty for those students who briefly traveled through foreign-speaking countries, gains were reported by the students in terms of attitudes, renewed interest in foreign languages, and in some cases regret that they had not mastered a language combined with determination to learn one at the earliest opportunity.
5. There was no statistically significant change in the ethnocentrism of authoritarianism of the group. There was, however, a statistically significant reduction in political-economic conservatism. Writings by the students indicated a reduction in ethnocentrism. They reported verbally (in seminars) a decrease in authoritarianism several weeks after their return home.
6. The students gained in self-perception according to their writings. The profile of the values of students (Allport-Vernon: A Study of Values) remained fairly stable.
7. Without exception, the students gained in their general knowledge of the current affairs, important persons and the problems of the area visited. These gains were not the result of formal classroom work.

Many studies are concerned with the impact of the United States on the foreign student, and rightly so. With the ever-increasing number of U. S. students traveling and pursuing their education abroad, it is important that the effects of this activity on these students be carefully analyzed. It is important that orientation for, and follow-up of foreign study and travel programs be planned in order to assure colleges and students of optimal benefits from such experience.

Microfilm $3.20; Xerox $10.80. 245 pages.

MINORITY GROUPS AND THEIR EDUCATION IN HAYS COUNTY, TEXAS

(L. C. Card No. Mic 59-4729)

Bruce Staffel Meador, Ph.D.
The University of Texas, 1959

Supervisor: Dr. George I. Sanchez

This study shows that arguments which attempt to explain personality as a function of "racial" inheritance are not tenable in the light of modern research. After discussing prerequisites for the highest development of anyone's personality, the study describes conditions in Hays County, Texas, which could inhibit personality development among many Latin Americans and Negroes living in the county.

One chapter contains the results of a teacher opinion survey conducted among rural schools in Hays County. This survey reveals a wide range in attitudes towards minority group students, but the majority indicate a predisposition not to think in racial terms except concerning the social dating of Anglo Americans and Latin Americans. Most of the teachers agree that Latin Americans are less of a discipline problem than Anglo Americans, but they would rather teach Angle Americans. According to the survey there is virtually no contact between teachers and parents of their Latin American students. There is a

widespread belief that Negroes should attend school with white students, but the interviewees stated or implied that the task of bringing about this integration was not their responsibility.

A detailed description of school attendance, chronological ages of students, and scholastic achievement in Hays County is included. These data are classified on the basis of whether they refer to Latin Americans, Negroes, or majority group members. This classification is used because it organizes the data into what appear to be significant categories, but the study emphasizes that this division is arbitrary and that the same data could be classified significantly into other categories.

Average daily attendance for the Latin Americans in 1955-1956 increased from 1260 in September to 1887 in February. This fifty per cent increase appears to be due to the children accompanying their parents in an annual migration in search of employment. The average daily attendance for Anglo Americans and Negroes decreased slightly as the year progressed.

Most of the Latin American children beyond the first grade in the San Marcos public schools were one or two years above normal age, and in the other Hays County schools most were two or more years above normal age.

The differential treatment received by minority group members in Hay County according to scholastic achievement tests results, as could be logically predicted, in differential responses. Although there is a great deal of overlap between the scores of the minority group children with the scores of other children, especially in the lower grades, the statistical median is different enough to indicate that the schools or the community, or both, are not organized in such a way as to develop the potential of many of its students. Microfilm $4.80; Xerox $16.00. 373 pages.

PERSONAL AGGRESSION AND OTHER CORRELATES OF THE ATTITUDE TOWARD THE USE OF MILITARY FORCE IN INTERNATIONAL RELATIONS

(L. C. Card No. Mic 59-5128)

Shinkichi Shimabukuro, Ed.D.
The Pennsylvania State University, 1959

The Problem

This study was concerned with the problem: What are some of the significant correlates of the attitude toward the use of military force in international relations? The study involved the demonstration of relationships between the attitude toward the use of military force and some variables. The variables were: (1) the personality needs of (a) aggression, and (b) abasement; (2) the sub-cultural variables of (a) urban-rural community backgrounds, (b) father's occupational classification, and (c) religious affiliation; (3) knowledge of facts; (4) sex, and (5) the attitude areas of (a) military preparedness, and (b) participation in international discussions.

The Procedure

The instruments.--Three attitude scales were constructed according to the scalogram analysis technique developed by Louis Guttman. The attitude areas were (1) the use of military force in international relations, (2) military preparedness, and (3) participation in international discussions. An information test consisting of items based on the international crisis situations of the period 1948 to 1958, and a questionaire to provide data on the subject's sex, hometown, father's occupation, and religious preference were also constructed. The Edward's Personal Preference Schedule was selected to measure the personality needs of aggression and abasement.

The population.--The instruments were administered to 308 seniors from three public high schools of Pennsylvania. The schools were selected on the basis of the type of community they served, i.e. rural, suburban, and industrial.

The analysis of the data.--Three statistical methods of demonstrating correlations were employed, i.e. product-moment correlation, biserial correlation, and point biserial correlation. Analysis of variance was done on the variables of father's occupational classification and religious affiliation.

Conclusions

Three significant relationships were demonstrated. Those who manifest strongly the need for aggression tend to be favorable toward the use of military force in international relations. This finding lends support to the commonly held postulate that personality maladjustments have some bearing on the general problem of international tensions.

A small positive correlation was found between the attitude favoring the use of military force in international relations and the attitude favoring military preparedness. A small negative correlation was found between the attitude favoring the use of military force and the attitude toward participation in international discussions. The intercorrelations between these three attitude areas were low, indicating that they are relatively independent attitude areas.

The attitude toward the use of military force was not found to be significantly related to the personality need of abasement, the three sub-cultural variables, knowledge of facts, and sex. Important inferences, however, may be drawn from this fact.

The failure to demonstrate a significant relationship between the attitude favoring the use of military force, while personal aggression was found to be related, seems to indicate that only certain kinds of personality maladjustments are relevant to the general problem of world tensions.

The fact that none of the sub-cultural variables were found to be significantly related to the attitude toward the use of military force seems to indicate that the population studied was homogeneous with respect to this attitude in spite of differences that might exist in sub-cultural backgrounds.

It is also important that a positive relationship could not be demonstrated between the attitude toward the use of military force and knowledge of facts about international crises. If the teaching objective is one of developing competency in evaluating foreign policy in terms of "power realities," something more than the dissemination of information must be done. Consideration must be given to the mental hygiene of students.

Microfilm $2.00; Xerox $6.60. 137 pages.

THE ATTITUDES OF PENNSYLVANIA SECONDARY MATHEMATICS TEACHERS TOWARD THE INCLUSION OF ANALYTIC GEOMETRY, CALCULUS, AND STATISTICS IN THE HIGH SCHOOL PROGRAM

(L. C. Card No. Mic 59-4469)

Daniel Paul Spillane, Ed.D.
University of Pittsburgh, 1959

The purpose of this study was to determine the attitudes of Pennsylvania secondary school mathematics teachers toward the inclusion of analytic geometry, calculus, and statistics in the high school program. It also tried to determine their feelings of competency to teach these subjects if they were to become high school courses. Finally, it attempted to uncover any existing relationship between favorableness to these subjects and (1) feelings of teaching competency in the field; (2) mathematics preparation; (3) graduate education; (4) length of time in teaching; or (5) the size of the school in which the teachers were located.

The sample was a group of 380 Pennsylvania high school mathematics teachers who responded to a mailed check list. This represented a 76 per cent return from 500 check lists mailed to a random sample of 500 teachers.

It was found that the teachers were favorable to the inclusion of analytic geometry, calculus, and statistics in the high school program; that they felt these subjects filled a social need; and that these subjects offered special advantages to many students who would take them. The teachers also felt that the able high school mathematics students in our secondary schools could do the work of these subjects while still in high school.

This study also found that these secondary school teachers of mathematics felt competent to teach all three of the subjects. About half of the responding teachers felt they could teach any of the subjects with, at most, some personal review on their part.

In searching for relationships between favorableness to the three subjects and the other factors listed in the statement of the problem, it was found that favorableness to analytic geometry showed a small negative relationship with length of time teaching secondary mathematics, but no relationships with any of the other factors tested; favorableness to calculus showed a small positive relation with the teachers' feelings of competency to teach calculus, a small negative relation with the length of time teaching secondary mathematics, but no relationship with the other factors; and favorableness to statistics showed a small positive relationship to feelings of competency to teach statistics, and to the mathematics preparation of the teachers, but no relationship with the other factors.

The major conclusion of the study was that since the secondary mathematics teachers of Pennsylvania both favor the inclusion of these subjects in the high school program and feel competent to teach these subjects, new programs which might be started in these areas should not be expected to encounter much opposition from teachers of high school mathematics.

Microfilm $2.00; Xerox $4.00. 72 pages.

THE SUPERVISION OF INDUSTRIAL ARTS IN PENNSYLVANIA

(L. C. Card No. Mic 59-4470)

Ralph Victor Steeb, Ed.D.
University of Pittsburgh, 1959

The purpose of this study was to determine the status of supervision of industrial arts in the public schools of Pennsylvania and to ascertain and compare the opinions of secondary school principals and industrial arts personnel with respect to certain supervisory practices and types of supervisory organization.

The first objective was to determine the educational and personal backgrounds of the industrial arts teachers and their supervisors. The second objective was to ascertain the present provisions for the supervision of industrial arts and supervisory personnel preferred by principals and industrial arts personnel. The final objective was to ascertain and compare the judgments of principals and industrial arts personnel of the value of certain supervisory practices which were being used and the judgments of these persons concerning the potential value of certain supervisory practices which were not being used.

A questionnaire was used to obtain primary data from industrial arts teachers, principals, vocational directors, and industrial arts supervisors. The questionnaire was constructed to include supervisory practices and types of supervisory organization which a review of the supervisory literature revealed as applicable to industrial arts. Random sampling was the procedure employed to identify the teachers used for this study. Principals selected for the study were those who administer the schools in which the teachers of the random sample were employed. Since the number of vocational directors and industrial arts supervisors was small, each director and supervisor was mailed a questionnaire.

In respect to local supervision, almost half of the industrial arts teachers reported being supervised by an administrator or curriculum coordinator. Far fewer teachers reported being supervised by special supervisors of industrial arts or by combinations of administrators with special supervisors. A small number of teachers reported experiencing no supervision. The industrial arts teachers place a higher value on the supervisory assistance of the special industrial arts supervisors and vocational directors then they do on the supervisory help of administrators and curriculum coordinators.

County superintendents were reported to participate in supervising industrial arts in only a few local school districts and were least preferred as supervisors of industrial arts in the judgments of the respondents.

Supervision of the local industrial arts program from the state level by an area coordinator of trade and industrial education was reported by approximately half of the teachers and principals. The teachers judged the coordinators' supervision to be of slight value, but the principals believed it had much greater value.

The extent of use and value of the following supervisory practices were included in this study: classroom visitation, intervisitation, teachers' meetings, individual conferences, demonstration teaching, bulletins and notices, professional study and activities, tests and measurements, lesson plans, shop planning and improvement, equipment and supply management, and audio-visual aids.

Some of the more important recommendations were the following. The supervision of industrial arts by a specialist should be available to all industrial arts teachers. Consolidation of school districts was recommended to increase the number of industrial arts teachers within individual districts making possible the appointment of local department heads or supervisors. County or regional industrial arts supervisors should be employed to supplement existing local supervisory personnel. To administer and direct these county or regional industrial arts supervisors, a state industrial arts supervisor should be appointed.

Microfilm $3.35; Xerox $11.40. 259 pages.

A STUDY OF GROUPING PRACTICES IN LARGE AMERICAN HIGH SCHOOLS

(L. C. Card No. Mic 59-4369)

Charles Herman Tidwell, Ed.D.
The University of Nebraska Teachers College, 1959

Adviser: J. Galen Saylor, Ph.D.

Statement of the Problem

The purpose of this study is to determine the practices in use in large American high schools for grouping pupils in various classes and to make an analysis of the problem of grouping in American high schools as revealed in the literature.

Procedures

A questionnaire for gathering information on all aspects of grouping procedures was prepared. The items were selected after a thorough study of systems of grouping reported in the literature, and of those used in large Nebraska high schools. The items included not only practices still in use, but also those that have been discarded and those that have been suggested but not put into practice. The questionnaire was sent to 1062 principals in large high schools of the North Central Association. From the 757 questionnaires that were returned grouping practices were analyzed.

Findings

The methods used most frequently to group pupils in English classes are: (1) mental ability, (2) recommendations made by previous teachers, (3) previous grades earned in English, (4) achievement test scores, (5) reading test scores, and (6) the student's choice of course or curriculum.

Students were grouped very similarly in mathematics and science. The most frequently used factors used for these areas are: (1) mental ability, (2) previous grades earned in the subject, (3) recommendations made by previous teachers, (4) achievement test scores, (5) choice of curriculum or course, and (6) aptitude test scores.

In sectioning for social studies ability grouping is not used nearly as much as it is for English, mathematics, or science. Heterogeneous grouping was favored in 24 per cent of schools; failure to indicate the use of ability grouping in this field implies even greater incidence of heterogenous grouping. Those doing heterogeneous grouping in social studies report use of the following factors: (1) mental ability, (2) previous grades earned, (3) recommendations by previous teachers, (4) achievement test scores, (5) choice of curriculum or course, and (6) reading test scores.

Students in the vocational and practical subject area are grouped on the following bases: (1) choice of course or curriculum, (2) special abilities that apply to those subjects, (3) recommendations of previous teachers, (4) mental ability, (5) previous grades earned in the subject, and (6) aptitude test scores.

Grouping in physical education when practiced, is based on the following factors: (1) sex of student, (2) physical handicaps, (3) health record, (4) physical maturation and development, (5) chronological age, and (6) special abilities in physical education.

The factors most often used in grouping are, listed in order: (1) mental ability, (2) previous grades earned in the subject field, (3) recommendations by previous teachers, (4) achievement test scores, (5) choice of high school curriculum or course, (6) aptitude test scores, (7) reading test scores, (8) special abilities that apply to particular subjects, and (9) the sex of students.

In guiding students into electives the following qualifications were most frequently reported: (1) the elective is required or highly recommended because the student is majoring in a particular course, (2) the student is recommended for the elective by teachers, counselors, etc., (3) the student has high scholastic standing in all previous work, (4) the student has special abilities that apply in the subject field of the elective, (5) the student has high I.Q., (6) the student has high scores on aptitude tests for the subject or the particular elective, (7) the student shows latent ability for the subject or the elective.

Conclusions

High Schools of this type practice homogeneous grouping on some selected criterion to a larger extent than is often thought to be true.

The use of a genuinely student-centered system of guidance is greatly needed to make any system of homogeneous grouping work.

There remains a great need for a thorough, comprehensive study of the merits of the various plans for grouping.

A comprehensive bibliography is included in the paper.

Microfilm $2.80; Xerox $9.60. 215 pages.

AN INVESTIGATION OF THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY IN SELECTING FOR THE ADVANCED AIR FORCE RESERVE OFFICER CORPS AT PURDUE UNIVERSITY

(L. C. Card No. Mic 59-4188)

John Ward, Ph.D.
Purdue University, 1959

Major Professor: Dr. Lee E. Isaacson

This investigation was an attempt to evaluate the use of the Minnesota Multiphasic Personality Inventory assumed to be related to the successful completion of the Advanced AFROTC program at Purdue University.

Using a group of 225 students enrolled in the Advanced AFROTC program data were collected on the clinical and special scales of the Minnesota Multiphasic Personality Inventory, Purdue English and Mathematics tests, the academic and military cumulative indexes, the Officer Quality and Verbal composites of the Air Force Qualification Test, and the Selection Board Ratings.

Two approaches were used in analyzing the data. Pearson r's were computed between the scores on each variable, and between each variable and the pass-fail criterion. The intercorrelation matrix was used to select variables for a coefficient of multiple correlation. Multiple R's were computed, the b weights were derived and a composite score prediction equation determined.

In the second approach, 59 pairs were formed through a matching procedure and used to analyze the significance of the Selection Board Rating scores. The difference between the means was tested for its "t" value and found to be significant at the five per cent level.

The distribution of the scores on the Selection Board Rating variable was scrutinized for the possibility of establishing a cutting line for selection.

It is concluded that:

1. The selection procedures accomplished prior to the experimental group enrolling in the program seriously restricted the scores obtained on the experimental variables.

2. Although a significant relationship was found between the D scale of the Minnesota Multiphasic Personality Inventory and the criterion it does not warrant being included in the selection procedure.

3. The cumulative indexes, academic and military, were the most efficient predictors of success for the group used in this study.

4. The Air Force Officer Qualification Test composites used with this group made no contribution and their use is questionable for this criterion.

5. The Selection Board Rating scores significantly predicted the criterion, but the distribution of scores was too platykurtic to be efficient in establishing a cutting line for selection. Microfilm $2.00; Xerox $7.00. 150 pages.

AN ANALYSIS OF THE PLANE GEOMETRY CONTENT OF GEOMETRY TEXTBOOKS PUBLISHED IN THE UNITED STATES BEFORE 1900

(L. C. Card No. Mic 59-4479)

John Donald Wilson, Ed.D.
University of Pittsburgh, 1959

The purpose of the study was to trace and analyze the evolution of the plane geometry content of geometry textbooks published in the United States before 1900. Twelve of the textbooks examined were published during the 1811-1837 period of years, 13 in the 1838-1863 period, 18 in the 1864-1881 period, and 18 in the 1882-1899 period. In order that trends might be ascertained the data were grouped and analyzed according to these four periods.

From the title pages, prefaces, and introductions of the textbooks information was obtained about the authors, their purposes, their statements of the aims of geometry instruction, and other related items. Two general types of aims were found. One type was concerned with mental discipline, while the other type included aims related to the acquisition and application of geometric information. Aims of the disciplinary type, which were emphasized more than the second type, appeared with nearly equal emphasis in the four periods of years.

An analysis of the fundamental assumptions provided information about the axioms, postulates, definitions, symbols, and the treatment of parallel lines. Seventy-five distinctly different statements of mathematical truths classified as axioms by the authors, and 23 different statements of geometric truths classified as postulates were included in the textbooks. Authors differed greatly in the number and nature of the fundamental assumptions they presented.

An analysis of the propositions provided information about the number of demonstrated propositions, the nature of the theorems, the form of the demonstrations, and the geometric constructions. The 61 geometries differed greatly in the number of demonstrated theorems, the number of solved geometric problems, and the number of corollaries included.

Student exercises, the feature of geometry textbooks which showed more evolution than any other, were classified and discussed according to the purpose of the exercise, and also according to the type of the exercise. Many examples of exercises of each type are cited in the dissertation. Ten of the 22 geometries before 1858 contained exercises, and all of the 39 from 1858 to 1899 included them. Other teaching and learning aids examined were: tables of contents, suggestions to teachers, historical references, keys for teachers, appendices, indexes, summaries, and tables of etymologies. The number of textbooks including each of these aids, except the table of contents, was small.

The analysis of the 61 geometries warranted several conclusions. Toward the close of the nineteenth century many evidences were found to indicate that authors were becoming much more aware of the learner and the learning process. The authors were generally competent mathematically, but were not very familiar with good teaching techniques and the learning process. Generally there was not a well-defined body of subject matter in place geometry. In conclusion it may be said that there has been a more evolutionary development of plane geometry textbooks than has been commonly believed.

Microfilm $3.35; Xerox $11.40. 259 pages.

PREDICTION OF ACADEMIC SUCCESS IN HIGH SCHOOL FROM PERSONALITY TRAIT RATINGS OBTAINED FROM THE PERSONALITY RECORD

(L. C. Card No. Mic 59-4480)

Stanley A. Zingle, Ed.D.
University of Pittsburgh, 1959

The statement of the problem investigated can be stated in question form as follows: How effective are personality-trait ratings obtained through the use of the Personality Record, as predictors of academic success in high school when that success is measured by quality-point average at graduation? The method used involved finding the

correlations between (a) the total personality-trait ratings at the end of the ninth grade and quality-point average at graduation; (b) the total personality-trait ratings at the end of the tenth grade and quality-point average at graduation; (c) each individual personality trait at the end of the tenth grade and quality-point average at graduation; and (d) each personality-trait and each of the other personality traits. Two partial correlations were also computed. The first found the correlation between total personality-trait ratings and quality-point average with the factor of mental ability held constant, and the second found the correlation between total personality-trait ratings and quality-point average with the factor of achievement, as measured by standardized achievement tests, held constant. Comparisons of the findings of this study with those of Walter M. Ritenour and Marion E. Gardner, who sought to find the relationship between another set of personality traits and various criteria under presumably ideal methodology, were made.

The most significant findings of this study are as follows:

1. Four of the traits, Seriousness of Purpose, Industry, Initiative, and Responsibility, were found to correlate very highly with Quality-Point Average, and three of the traits, Emotional Stability, Influence, and Concern for others, were found to correlate to a marked degree.

2. Total personality-trait ratings obtained at the end of the tenth grade was found to correlate higher with Quality-Point Average than any of the individual trait ratings (.80).

3. Total personality-trait ratings obtained at the end of the ninth grade was found to correlate more highly with Quality-Point Average than mental ability as measured by a group mental ability test (.71).

4. For prediction purposes, the personality-trait ratings obtained through the use of the Personality Record are just as effective as the ratings which are obtained through the use of rating scales which abide by accepted criteria in the use of rating scales.

Prediction equations utilizing the findings of this study were computed. Simple regression equations for predicting Quality-Point Average from (a) total ninth-grade personality-trait ratings, (b) total tenth-grade personality trait ratings, (c) a single personality trait, were computed. A multiple regression equation for predicting Quality-Point Average from total personality-trait ratings and mental ability was computed.

The most significant conclusion found in this study is that the Personality Record, which violates many of the accepted criteria governing the use of rating scales is as highly predictive of academic success in high school as other rating scales which abide by expert opinion in the use of rating scales. Of great importance also is the conclusion found that, from a predictive point of view, the ratings a student receives at the end of his ninth or tenth grade are just as significant or more so, than his mental ability. Microfilm $2.00; Xerox $4.80. 94 pages.

EDUCATION, ADMINISTRATION

ADMINISTRATIVE POLICIES AND PROCEDURES IN HIGH SCHOOL PUPIL DISCIPLINE

(L. C. Card No. Mic 59-3506)

Thelma Irene Barnes, Ed.D.
University of Southern California, 1959

Chairman: Professor LaFranchi

The problem was to study the referral practices of high school teachers and the administrative handling of referred discipline cases, in an effort to determine the relative responsibility of teacher and administrator in dealing with pupil misbehavior.

The study was conducted as a survey of existing and recommended practice, making use of the critical incident technique as developed by Flanagan. Administrators reported an effective and an ineffective referral from a classroom teacher; teachers reported a case showing effective administrative handling of a referral and one showing ineffective administrative handling. The study is based on 1,283 critical incidents, 388 reported by administrators and 900 reported by teachers. Statistical facts obtained from the incidents were classified, machine tabulated, and analyzed. The anecdotal materials were further studied to obtain information not subject to statistical tabulation.

Findings. Effective referral procedures of teachers were found to be these: immediate referral of serious emergencies; referral only after using many teacher resources; referral with complete, accurate information; referral of serious out-of-class problem; consultation with the discipline administrator in advance of referral; bringing pupil to the office; arrangement for pupil-teacher-administrator conference; referral for help that teacher cannot provide; immediate pupil referral in cases where parents caused school problems; and requiring pupil to write the facts of the referral himself.

Ineffective referral procedures were found to be these: referral of classroom nuisance cases, best handled by good teaching; referral without previous personal counseling of pupil; referral with notification that pupil be dropped from class; referral with incomplete or inaccurate statements; allowing serious cases to go to the crisis stage before referral; sending pupil to the office with no note; and advising administrator how to handle the case.

Effective administrative procedures in handling referrals were found to be these: guidance conference with pupil; suspension with required parent conference; conference with parents; changing pupil's program after notifying the teachers involved; withdrawing privileges related to the misbehavior; contacting parents by letter, telephone, or home visit; counseling a group of pupils; pupil-parent-teacher conference; expulsion of pupil; and arranging for pupil to apologize easily and promptly.

Ineffective administrative procedures were found to be these: failure to notify teacher of any action taken; merely talking to or admonishing pupil; changing pupil's program without notifying the teachers involved; suspending pupil for brief time; dropping the case; reprimanding a group for the misbehavior of one pupil; assigning brief periods of detention; withdrawing privileges not related to the misbehavior; requiring or forcing pupil to apologize;

returning pupil to class the same period he was referred; and according to the wishes or threats of parents.

Recommendations. It was recommended that teachers (1) refer at once serious emergency cases; (2) consult the administrator before referral in cases of less severity but of a persistent nature; (3) handle classroom nuisance problems themselves; (4) provide vital, well-organized instruction in an effort to prevent most classroom disorders; (5) make use of good guidance techniques; (6) consult the discipline administrator for assistance concerning classroom controls; (7) study the dynamics of human behavior; (8) maintain self-control; (9) assign just, reasonable penalties; (10) keep accurate, complete pupil personnel records; (11) leave decisions to administrators in referred cases.

It was recommended that administrators (1) prepare a written statement outlining the responsibilities of teachers in making referrals and of administrators in handling referrals; (2) provide teachers with advice and assistance in handling pupil misbehaviors through in-service training programs, faculty meetings, and conferences; (3) keep teachers informed regarding the handling of their referred cases; (4) use good guidance techniques; (5) work actively to secure home-school cooperation; and (6) use such authoritarian measures as physical punishment and expulsion when indicated, especially if guidance techniques and home-school cooperation fail to solve discipline problems.

Microfilm $5.25; Xerox $18.40. 410 pages.

UNIFIED AND COMMON ADMINISTRATIVE DISTRICT PREVENTIVE MAINTENANCE PRACTICES

(L. C. Card No. Mic 59-3507)

John Earl Baron, Ed.D.
University of Southern California, 1959

Chairman: Professor Nelson

The purpose of this investigation was to analyze preventive maintenance programs in public school districts and to determine desirable standards for preventive maintenance programs. More specifically, the study sought to ascertain present practices, policies, and standards regarding the following: (1) maintenance policies, (2) maintenance procedures, (3) maintenance practices, (4) maintenance standards, (5) maintenance schedules, (6) replacement criteria, and (7) maintenance costs.

Examination was made of all available literature. A national survey was undertaken to locate unpublished information relating to preventive maintenance practices. Eight state departments of education purporting to have maintenance services for their school districts were surveyed. The forty-one California unified and common administrative districts with more than forty-five hundred and less than eighty-five thousand average daily attendance and with a representative in the California Association of Public School Business Officials became the population. A questionnaire identified the twelve districts which became the interview sample. An intensive interview consisting of three parts was used to investigate twelve sample districts.

Findings. (1) No specific preventive maintenance schedules were obtained on the national level. (2) Of the eight state departments of education reported to be actively providing schools with maintenance services, not one was so engaged. (3) Of the forty-one school districts to whom questionnaires were sent, thirty-six responded. Twelve of the respondents answered all items affirmatively that they had a preventive maintenance program and became the sample. (4) Responses were obtained which indicated that records were kept on most of the equipment and building items. (5) The districts had most of the record content items, had few of the property management items, followed few of the posting practices, and employed few of the possible uses of maintenance records. (6) The budget was developed through an annual survey. (7) Major repair jobs were contract jobs. (8) Custodians performed minor maintenance. (9) Poor architectural use of maintenance knowledge when new facilities were designed was a common complaint. (10) Exterior and interior buildings and grounds were inspected annually by the craftsmen under whose jurisdiction the repair would be assigned. (11) Exterior and interior painting was accomplished every five or six years. (12) Replacement was upon exhaustion of the item. (13) Equipment was inspected annually by the craftsmen under whose jurisdiction the repair would be assigned. Breakdown repair of equipment was common. (14) There was no equipment painting schedule. (15) Other findings are listed in the dissertation.

Conclusions. (1) Preventive maintenance has not been given the attention it should have in California public schools. (2) Many of the maintenance flaws in school construction have been perpetuated year after year throughout the state. (3) School districts in California need to develop preventive maintenance programs. (4) A good preventive maintenance program incorporates inspection schedules, well-defined work schedules, adequate staffing, adequate budget, sound functional organization, and usable records. (5) The most important factor for a successful preventive maintenance program is the promotion of the preventive attitude among maintenance and operation personnel. (6) Too much time was taken from the maintenance budget to perform capital expenditure activities.

Recommendations. (1) A clear line and staff organization with unit responsibility resting in the hands of a head of buildings and grounds is recommended. (2) A minimum reporting plan for a complete maintenance program requires a summary of accomplishment and activity for a given period of time. (3) Replacement considerations should include inadequacy and obsolescence as well as exhaustion and excessive repair costs and frequencies. (4) Maintenance inspection of buildings and grounds should take place at least annually. (5) Equipment should be inspected for maintenance needs at least annually. (6) Inspection schedules should be recorded and filed by an inspector. A check system for times of inspection should be used. (7) Other recommendations are included in the dissertation. Microfilm $3.05; Xerox $10.60. 236 pages.

INSPECTION AND MAINTENANCE OF PUBLIC SCHOOL BUSES IN CALIFORNIA

(L. C. Card No. Mic 59-3508)

Ralph Rogers Bell, Ed.D.
University of Southern California, 1959

Chairman: Professor Nelson

The purpose of this study was to determine desirable procedures for the inspection and maintenance of public school buses in California. The study involved an analysis of related research, literature, legal aspects, commercial procedures, school procedures, and criteria for desirable procedures.

There were 193 school districts in California that employed a business official. An anecdotal-type questionnaire regarding various aspects of the inspection and maintenance of school buses, both contract and district owned, was sent to each district. A total of 127 questionnaires (66 per cent) were completed and returned. Fifteen school districts had no school buses.

A panel of twelve specialists in school transportation, government transportation, and school business management was sent a questionnaire designed to secure reaction to suggested criteria. All twelve specialists completed the questionnaire, and the answers were tabulated and utilized in the study.

Findings. (1) A total sampling of 1,822 buses was composed of 1,317 district-owned buses (72 per cent) and 505 contract buses (28 per cent). (2) Contract buses had 23 per cent of the total mileage for all buses and transported 17 per cent of the total numbers of pupils. (3) Prior to placement into service each new, or used, school bus was inspected in compliance with written district specifications by 48 per cent of the districts that owned buses and by 16 per cent of the districts that had contracted buses. (4) Fifty-five per cent of the districts with contract buses received no written bus driver inspection reports showing the condition of each bus. (5) Established mechanical inspections were made at regular intervals by 71 per cent of the districts that owned buses and by 23 per cent of the districts that contracted for transportation. (6) Eighty-nine school districts (86 per cent) reported having a preventive maintenance program for district-owned buses. Preventive maintenance schedules were used by 43 per cent of these districts. (7) Eighty-two per cent of the school districts reported they kept a historical record on the maintenance of each school bus. (8) Practices and policies pertaining to school bus inspections and maintenance were reported to be in printed form in 11 per cent of the total school districts. (9) Six types of bus inspection and maintenance reports and twelve types of accounting record forms were utilized by school districts. (10) The jury of specialists approved twenty-one criteria for desirable procedures.

Conclusions. (1) The specialists agreed that a preventive maintenance and inspection schedule should be adopted by school districts. (2) There is a need for school districts to determine that proper preventive maintenance and inspection procedures will be observed by independent contractors. (3) There is a need for the development of desirable inspection and maintenance procedures for school buses in many districts in California. (4) There is a need for school districts to maintain inspection and maintenance reports and records.

Recommendations. (1) School boards and school officials should place the inspection and maintenance of school buses on a policy basis. (2) Each school district should adopt an inspection and preventive maintenance schedule to fit local conditions. (3) School districts should require independent contractors to have standards of bus safety that at least equal the standards adopted by the districts. (4) A state agency should closely supervise the inspection procedures and maintenance records for all school districts and independent contractors.

Microfilm $3.50; Xerox $11.80. 269 pages.

ADMINISTRATIVE PROBLEMS OF PRODUCTION IN THE HIGH SCHOOL PRINT SHOP

(L. C. Card No. Mic 59-4870)

Ralph R. Black, Ed.D.
Bradley University, 1959

It is the purpose of this study, first, to survey present practices in high school print shops in regard to production work in an effort to determine what factors seem to be instrumental in making production work an administrative problem in some schools, and, second, to attempt to ascertain what can be done to alleviate the situation where it is considered a problem.

The pertinent data for the study were obtained by means of questionnaires mailed to approximately five hundred graphic arts teachers in senior high schools throughout the United States. The questions were designed primarily to elicit information concerning the role of production printing in the graphic arts programs of the schools, and to establish factors which might be responsible for making production work a problem.

The returns from the survey indicate that:

1. Production work for other departments of the school is almost a universal practice in senior high school print shops.
2. The practice of doing general commercial printing in school shops is almost non-existent. However, a considerable number of schools do some printing for certain out-of-school groups.
3. Instructors are almost unanimous in their approval of the use of some controlled production work in printing classes.
4. Approximately one-third of the instructors consider production work a major problem in their shops.
5. The factor which appears to be of greatest significance in making production a problem is the lack of a workable plan for controlling production. This seems to be due principally to the inability of the instructor to organize effectively for production work or to a lack of cooperation between the administrator and the printing instructor.
6. An overload of production jobs is a significant factor in making production work a problem in a number of shops.
7. The three factors considered by instructors as being most instrumental in making production work a problem are: (1) rush jobs, (2) too much production work, (3) too much of instructor's time taken up with production work.

One chapter of the study is devoted to a discussion of the educational use of production work in the school shop, and a number of specific recommendations are made for alleviating the production problem.

Microfilm $2.70; Xerox $9.20. 205 pages.

IDENTIFICATION AND VALIDATION OF MAJOR PRINCIPLES OF SUPERVISION AND THEIR APPLICATION IN SELECTED SECONDARY SCHOOLS

(L. C. Card No. Mic 59-4364)

Gordon Charles Bliss, Ed.D.
The University of Nebraska Teachers College, 1959

Adviser: Dr. J. Galen Saylor

Statement of the Problem

The purpose of this study has been the identification and validation of major principles of supervision and their application in selected secondary schools.

Procedures

A tentative list of principles was formulated, utilizing research studies and the writings of authorities in the field of supervision. The validity of these principles was determined by the judgments of a jury of specialists on secondary school supervision, by the ratings of selected principals of secondary schools, and by the extent to which these principals carry out supervisory acts consistent with the principles of supervision accepted by the specialists.

A jury, questionnaire, and personal interviews were the basic techniques used. Nineteen authorities in the field of supervision rated and made criticisms concerning the principles developed by the writer. State superintendents or commissioners of education in each of the nineteen member states of the North Central Association of Colleges and Secondary Schools were asked to recommend secondary school administrators carrying out superior supervisory programs in their respective schools. The study was limited to school districts having one public secondary school. One hundred twenty-three administrators were recommended and received questionnaires. Ninety-three completed the questionnaire relating to his background, rated principles of supervision, and checked to what extent certain activities related to the major principles of supervision were practiced. Personal interviews were conducted with fifteen of the participants to provide more specific information on the activities and principles.

Findings

1. Thirty principles of supervision were accepted as valid and of major significance on the basis of the ratings of the jury. Other principles of supervision on the list are subordinate to these thirty principles.

2. The administrators accepted the thirty principles of supervision as valid and proper. However, they were not in complete agreement with three of these. These were:

(a) Supervisory responsibilities are shared by staff members to a degree.

(b) All individuals and groups concerned participate in supervisory planning.

(c) Supervisory plans include a flexible outline of procedures for arriving at objectives and evaluating results.

3. The administrators felt that five of the thirty-eight principles included in the tentative list should have been accepted as valid. Two of these principles stated:

(a) Supervision is philosophic.

(b) Supervision is professional.

The other three principles favored by the administrators, which were not in complete agreement with the principles of creative and cooperative supervision advocated by the specialists, were not accepted as major principles in this study.

4. This study revealed weaknesses in the philosophy and training of administrators with reference to the thirty accepted principles of supervision. The study shows the need for persons responsible for the supervisory program in secondary schools to develop a better understanding of the cooperative approach to supervision as well as activities associated with this aspect of supervision.

Conclusions

1. Continual action research is needed with respect to major principles of supervision and the changing concept of the comprehensive high school.

2. More extensive use of the cooperative program should be encouraged.

3. Supervisors should be encouraged to make wider use of all activities commonly associated with the major principles of supervision.

4. Teachers should be given greater freedom in self-direction, self-expression, and self-evaluation in the supervisory program.

5. Graduate schools need to give attention to programs of training persons responsible for the supervisory programs in secondary schools. This training should include: (a) group dynamics, (b) cooperative procedures in supervision, and (c) diagnostic research to aid in evaluation of the supervisory program.

6. Provisions should be made for the widespread exchange of ideas, methods, and activities in the supervisory program.

Microfilm $4.35; Xerox $14.60. 340 pages.

A STUDY OF THE PERMANENCE OF SEVENTH, EIGHTH, AND NINTH GRADE TEACHERS IN MICHIGAN

(L. C. Card No. Mic 59-2632)

Ray Budde, Ed.D.
Michigan State University, 1959

Major Professor: William H. Roe

The problem. There has been much concern during the last decade about the rapid turnover of teachers in grades seven, eight, and nine. These grades have been labeled by many as being the most difficult to teach. They should be staffed, as should all grades in public education, with qualified, permanent teachers. This study seeks to compare the permanence of seventh, eighth, and ninth grade teachers in Michigan with the permanence of teachers of other grades in Michigan.

Methodology. Tippett's random numbers were used to draw a 10 per cent sample of school systems of Michigan. With the letterhead of the Michigan Secondary School Association, contact letters were sent to the superintendents of these systems requesting permission for teachers of all grades to participate in the "Michigan Teacher Personnel Study." Affirmative answers were received from thirty-four of the thirty-five superintendents. Eighty per cent of the 3471 questionnaires sent out were returned.

The data were analyzed by use of the chi-square statistic to test significance of differences. The number values were used in the statistical analysis; tabular information was generally presented in percentages. It was possible to chart actual patterns of mobility for each grade from 1947 to 1957.

Findings and conclusions. The significant findings of this study were as follows:

(1) Seventh, eighth, and ninth grade teachers were less permanent in classroom teaching than teachers in all other grades except grade ten. Considered as a grade group, teachers in grades seven, eight, and nine were less permanent than teachers in any other grade group.

(2) Three hundred forty-nine teachers were needed per hundred available teaching positions in seventh grade from 1947 to 1957; 352 in eighth grade; and 312 in ninth grade. These compared with 320 teachers needed per hundred available teaching positions in tenth grade; 247 in twelfth grade; 270 in sixth grade; and 223 in kindergarten, the grade with the lowest rate of turnover.

(3) Seventh, eighth, and ninth grade women teachers were less permanent than women teachers in other grade groups. Seventh, eighth, and ninth grade men teachers were less permanent than women teachers in their same grade group and men teachers in senior high school.

(4) Seventh, eighth, and ninth grade teachers in large school systems were more permanent in classroom teaching and in grade than seventh, eighth, and ninth grade teachers in small systems. Seventh, eighth, and ninth grade teachers in both large and small systems were less permanent in classroom teaching than senior high school teachers in their respective sized systems.

(5) Seventh, eighth, and ninth grade teachers were younger and had fewer years of teaching experience than did teachers in other grades.

(6) "Discipline problems" was given as the main reason by teachers for disliking to teach seventh, eighth, and ninth grade students. "Professional and salary advancement" and "the desire to teach more challenging subject matter" were the two most frequently given reasons for changing from grades seven, eight, and nine.

(7) Virtually the only sources of supply for senior high school vacancies from 1947 to 1955 (except for teachers who started directly in the senior high grades) were seventh, eighth, and ninth grade teachers.

The findings of this study when used with projected public school enrollment figures for Michigan point toward a critical shortage of qualified teachers for grades seven, eight, and nine from 1958 to 1963. Present efforts of teacher training institutions to devote more attention to training teachers for junior high school work need to be expanded. Long-term improvement in permanence of staff in these grades depends on the acceptance of the idea that the early adolescent is sufficiently different from those younger and older to warrant a distinctive kind of educational program and that this program should be staffed by qualified teachers who are as permanent in their positions as are teachers in other grades.

Microfilm $2.75; Xerox $9.40. 209 pages.

SOURCES OF INFORMATION REGARDING UNIVERSITY COLLEGE COURSES

(L. C. Card No. Mic 59-3510)

William A. Carmody, Ed.D.
University of Southern California, 1959

Chairman: Professor LaFranchi

The purpose of this study was to determine the relative effectiveness of techniques in publicizing general liberal arts and science courses for non-degree-seeking students in University College, the University of Southern California night division.

The following brief statements present the major steps of the procedure. (1) Data were gathered on these students enrolled in the 1957 spring semester. (2) First-time enrollees were surveyed to determine effectiveness of night division publicity upon their decisions to enroll. (3) Surveys were made to determine interest in liberal arts and sciences for non-degree-seeking students. Findings guided preparation and distribution of special leaflets with attached reply cards intended to stimulate and determine interest in this type of education. (4) Surveys were made of all students enrolled in the 1957 fall semester to determine the effectiveness of night division publicity upon their decisions to enroll. (5) A survey was made of a sample of nonenrollees receiving publicity before the 1957 fall semester to determine (a) why they had not enrolled, (b) their reaction to the publicity, and (c) their interest in liberal arts and science courses on a noncredit basis.

Findings. (1) These students comprised approximately 3 per cent of the night division enrollment. Approximately 50 per cent were enrolled in drama, English, speech, and social sciences. The largest occupational groups were educators and aircraft employees. Ninety per cent lived within a fifteen-mile radius of the University. (2) Eighty-two per cent of the respondents were influenced to enroll by University College publicity. The most effective kinds were the bulletins, catalogs, persons as sources of information, and the "Announcements." Three of the 116 respondents lived within the census tracts where 30,000 "Announcements" were mailed. One respondent lived in the apartment areas where 9,610 sciences and arts leaflets were mailed. Although respondents learned of the night division in thirty-six ways, most students learned of the night division while attending day classes. (3) One person in 26 surveyed by double postal cards wanted further night division literature; 1 in 124 of the special leaflets group wanted additional literature. Approximately 1 in 800 of the special leaflets group listed others who might be interested. Few of these students received the special leaflets or worked where they were sent. (4) The two main reasons given for not enrolling for this kind of education were lack of time and that courses were considered too high in price; however, a number indicated they might enroll later.

Conclusions. (1) Most of these students are influenced

to enroll by night division publicity. Printed materials and persons are the most important sources of information. (2) The effectiveness of publicity is offset by reasons persons give for not enrolling. (3) The interest of prospects is considered in distributing the Bulletin of the University of Southern California which is sent to individuals only upon request. (4) It is not productive to send "Announcements" to census tracts nor to send leaflets to apartment areas. (5) A publicity problem exists because so few persons are interested in the education under study and because publicity is geared to degree-seeking students. (6) It is not productive to ask for referrals.

Recommendations. (1) There should be continuing efforts, and evaluation of such efforts, to interest persons in liberal arts and sciences on a nondegree basis. These efforts should utilize lists developed in this study which showed the most interest in this education, and such largely unused but promising points of distribution as public libraries. (2) Special efforts should be directed to educators and aircraft employees. (3) A study should be made to determine the feasibility of a night division program of informal courses in liberal arts and sciences.

Microfilm $3.70; Xerox $12.40. 285 pages.

A COMPARISON OF THE PENNSYLVANIA PUBLIC SCHOOL EMPLOYES' RETIREMENT SYSTEM WITH A SELECTED GROUP OF OTHER GOVERNMENTAL AND INSTITUTIONAL RETIREMENT AND PENSION SYSTEMS

(L. C. Card No. Mic 59-4435)

William Lawrence Charlesworth, Ed.D.
University of Pittsburgh, 1959

Adviser: M. J. Thomas

The purpose of this study is to compare the benefits accruing to members of the Pennsylvania Public School Employes' Retirement System with benefits to members of certain other governmental and institutional pension and retirement systems.

The retirement systems compared are the Pennsylvania Public School Employes' Retirement System, The State Teachers Retirement System of Ohio, Teachers Retirement System of the State of Maryland, West Virginia State Teachers Retirement System, Pension Fund of City of Pittsburgh, Allegheny County Employes' Retirement System, Policemen's Relief and Pension Fund of the City of Pittsburgh, Firemen's Relief and Pension Fund of the City of Pittsburgh, Commonwealth of Pennsylvania State Employes' Retirement System, United States Civil Service Retirement System (Employees), United States Civil Service Retirement System (Congressional Employees), and Railroad Retirement System.

The several systems were analyzed in the areas of types of retirement systems, eligibility requirements for membership, financial participation of employer and employee, qualifications for retirement, factors used in the computation of retirement allowances, formulas employed in the calculation of retirement allowances, options permitted at retirement, and allowances granted. In addition, comparisons were made of the provisions for disability retirement, early retirement, deferred allowances, Social Security coverage, loan privileges, survivor benefits, and death benefits.

It was found that the Pennsylvania Public School Employes' Retirement System is superior to the majority of the other retirement systems analyzed in providing an easily understood explanation of the benefits available to the members, a variety of retirement options, a minimum but no maximum limit on the retirement allowance, early retirement after a reasonable length of service and a periodic report to each individual member on the status of his retirement account.

The system is approximately equal to the majority of those with which it is compared in providing for compulsory membership of all new employees, representation from the membership on the retirement board, retirement funds on a full reserve basis, individual accounts, support of program through equal employer-employee contributions, withdrawal privileges, disability retirement, and a retirement allowance proportionate to the length of service performed.

Provisions made by the system which, although present, are inferior to those in the majority of the other systems analyzed are liberal retirement qualifications, interstate reciprocity, and the link with the Social Security program.

The Pennsylvania system makes no provision for deferred allowance, limited loans to members, survivor benefits other than accumulated contributions, and automatic payment to survivors of members who died while in retirement.

The study revealed that the system could be improved by providing for a deferred allowance for those with ten or more years of service credit, a reduction in the superannuation retirement age from sixty-two to sixty, a reduction in the service retirement age from thirty-five to thirty, death benefits for survivors of active members and automatic survivor benefits for dependents of deceased retired members, a more generous policy of reciprocity with other retirement systems, and limited loans to members. Microfilm $2.90; Xerox $10.00. 221 pages.

EMPLOYMENT PATTERNS IN THE SCHOOL SUPERINTENDENCY IN TEXAS

(L. C. Card No. Mic 59-4757)

Floyd William Cokendolpher, Ed.D.
The University of Texas, 1959

Supervisor: Dr. L. D. Haskew

The major purpose of this study was to examine the patterns of superintendency change in Texas. It was designed to throw light upon the employment conditions prevailing for superintendents of public schools. The specific purposes were concerned with a description of the particular phases of the superintendency change patterns; some of these topics related to why superintendents changed positions, the migration pattern, the pattern of departure from the superintendency, tenure, and criteria used in selecting superintendents.

The records of the Texas Education Agency from 1945 through 1954 were the basis for the data on the morphology of superintendency change in independent school districts.

Three questionnaires were also used. Those invited to respond to the questionnaires were the "current superintendents" who changed school positions between 1952 and 1954 and the "former superintendents" who dropped out of the superintendency in Texas during the same period; also all board presidents in the school districts identified with the above changes were included.

The number of respondents, together with the percentage of returns, for the different types of questionnaires were as follows: "Former superintendents," 98, or 32 per cent; "current superintendents," 164, or 57 per cent; and board presidents, 100, or 35 per cent.

In order to make comparisons possible some questions were repeated in each of the instruments. Moreover, each of the respondents was asked to check the school system size, by number of teachers employed, as follows: Class A, 5 to 14; Class B, 15 to 29; Class C, 35 to 74; and Class D, over 74 teachers.

The "current superintendents" in Class A districts had a median tenure of only three years--just one-half as long as those in the Class D systems. The trend during the decade of 1945 to 1954 was for longer tenure in the school superintendency.

Except in the larger school systems only a small proportion of the incumbents retired from the superintendency. The usual employment pattern of the "former superintendents" was to go into other types of educational work. Few of this group had any plans to return to the superintendency soon.

The main reasons for superintendency change, according to the "current superintendents," were opportunities for advancement, salary increases, and movement to more desirable communities. The board presidents indicated that several superintendents moved because of an undercurrent of protest against the superintendent within the community.

One-half of the "current superintendents" had never held a previous superintendency, although two-thirds of them had been high school principals. Few superintendents were promoted from within the system. Although each superintendency vacancy attracted about a dozen applicants, only three or four of the applicants were considered seriously for the position.

The school boards in larger school systems were usually more systematic than those in smaller systems about employing superintendents. The majority of school boards did not use written criteria for evaluating applicants nor did they use screening committees to eliminate applicants.

The employing school boards ranked the character of the applicant as the most important criterion of selection. Other criteria of major importance related to the ability of the applicant to work with the staff, with the board, and with the community. The educational qualifications of the applicant were of lesser importance.

Microfilm $3.50; Xerox $12.00. 271 pages.

AN ANALYSIS OF THE SCIENCE PROGRAM OFFERED IN THE PUBLIC SCHOOLS OF BELLEVUE, NEBRASKA

(L. C. Card No. Mic 59-4366)

Henry Edwin Cramer, Ed.D.
The University of Nebraska Teachers College, 1959

Advisers: Dr. Merle A. Stoneman and
Dr. Rosalie W. Farley

Statement of the Problem

The purpose of this study is to (a) analyze the present status of science instruction in the Bellevue, Nebraska Public Schools, (b) develop a list of science concepts which will constitute a sound science program from kindergarten through grade twelve, and (c) develop an in-service education program that will improve the science program in the Bellevue, Nebraska Public Schools.

Procedures

This study was divided into three parts. The first part was concerned with gathering from the literature information about established science concepts which should be taught in public schools. This information was developed into a questionnaire which was submitted to a jury of recognized authorities in science education. The responses of these jurors were tabulated, compared and analyzed. The status of the existing science program in the Bellevue Public Schools was reviewed and proposals developed for improvement.

Conclusions

1. There is a need for clarification of the terminology used in science education literature.
2. Authorities in the field have proposed science programs based on science concepts since the beginning of the twentieth century.
3. Religious influences and college entrance requirements were factors which affected the development of science teaching in the American public schools.
4. Authorities strongly support a planned continuous program of science instruction.
5. The goals of science education and the principles of in-service education are well defined in the literature.
6. A majority of the jurors suggested that (a) all of the concepts submitted were desirable for students to learn, (b) thirty-four of the forty concepts could be introduced on the lower elementary school level, and (c) one of the concepts should be introduced on the intermediate elementary school level.
7. Test results in the Bellevue Public Schools seem to indicate that many students have learned science facts but have not developed the skill of implementing the knowledge gained.
8. In the Bellevue Public Schools there is a need for (a) a system wide continuous science program, and (b) a ninth grade course in physical science.
9. The teachers in the Bellevue Public Schools have a higher average level of professional training as measured by college degrees than do teachers of similar academic areas on either the national or state levels.

10. The need for a comprehensive in-service education program exists in the Bellevue Public Schools and the resources in terms of time, place and finance are available.

Recommendations

1. Elementary teachers with unusual interest in science might be permitted to teach an additional class in science in the same building.
2. A physical science course should be made available to all students in grade nine.
3. A wide range of supplementary reading material should be made available in each classroom where science is taught.
4. A study should be made of the place of health in the science program.
5. The time allotted to science in the elementary grades should be more definitely established.
6. More use should be made of the scientific personnel which is available in the Bellevue community.
7. Science instruction should develop science concepts and the ability of the students to implement the knowledge gained.
8. Capable high school students interested in science should be encouraged to take four years of science.
9. Storage rooms for individual or small group projects should be made available.
10. More science equipment, especially in the elementary schools should be made available.
11. The existing administrative framework of the Bellevue Public Schools should be used to further develop a science in-service education program, and the activities suggested should be used to facilitate the widespread participation of the staff members.

Microfilm $3.65; Xerox $12.40. 284 pages.

A HISTORY OF SCHOOL ORGANIZATION AND ADMINISTRATION IN SANTA BARBARA COUNTY

(L. C. Card No. Mic 59-3514)

Ian James Crow, Ed.D.
University of Southern California, 1959

Chairman: Professor Nelson

The purpose of this study was to trace the growth and development of school organization and administration in Santa Barbara County. The study attempted to trace events in the history of the county and state that have affected school administration and show the past and present relationships between the County Superintendent of Schools, the County Board of Education, Boards of Trustees, and the administrators.

Findings. (1) The first legal action taken to create an administrative head to guide the schools of Santa Barbara County was voted by the legislature of the state in 1852; this act provided that the assessor of the county should also act as the County Superintendent of Schools. (2) The first school in Santa Barbara County was organized in 1796 at the Santa Barbara Mission; the operation of this school was directed by the mission fathers. (3) The first school fund in Santa Barbara County was created by law in 1854; this same year three school commissioners were named. (4) After 1856, some type of public school was in operation each year in the town of Santa Barbara and some of the other parts of the county. (5) The first school districts in Santa Barbara County were very large in area and sparsely populated, with a small percentage of eligible children attending school. (6) Santa Barbara County lost more than half of its school districts by the creation of Ventura County in 1873. (7) At one time, due to existing conditions, there were seventy separate school districts in the county, many of which have been reorganized through annexation and unionization. (8) Since 1896, there has been a gradual reduction in the number of school districts, the tendency being to reorganize into more efficient districts; the prevailing pattern being separate elementary and secondary districts with no unified districts in the county. (9) The County Board of Education has played an important role in coordination, leadership, in the provision of emergency services, and in the provision of advisory and consultant services to the local school districts.

Conclusions. (1) In accordance with generally accepted standards, there are too many school districts in Santa Barbara County. (2) Population increase in Santa Barbara County will continue, creating additional administrative and school districts organizational problems. (3) The patrons of school districts have shown their willingness to support free public education in Santa Barbara County. (4) The intermediate level of administration, the Office of the County Superintendent of Schools, has played a vital part in the organization and development of the individual school districts. (5) The trend of school administration in Santa Barbara County has progressed from no administrative units to a few administrative units, then to a great number of administrative units; the number then gradually decreased and will continue to decrease with further reorganization.

Recommendations. (1) Since many of the board minutes in the school districts of the county are not available, it is recommended that all school boards should ensure the permanency of their records. (2) It is recommended that the County Superintendent of Schools endeavor by suitable means to have this study brought up to date every ten years in the future. (3) Since many of the records of the Office of the County Superintendent of Schools are not available, it is recommended that steps be taken to ensure the permanency of all records of this office. (4) Effort should be made by the citizens of Santa Barbara County to work for the improvement of district organization in the county. (5) Salaries for the staff of the Office of the County Superintendent of Schools should be improved.

Microfilm $3.00; Xerox $10.40. 232 pages.

AN EVALUATION OF THE EFFECTIVENESS OF THE LATTER-DAY SAINT INSTITUTES OF RELIGION

(L. C. Card No. Mic 59-3516)

Paul Harold Dunn, Ed.D.
University of Southern California, 1959

Chairman: Professor Nelson

The purpose of this study was to determine (1) the objectives of the Latter-day Saint Institutes of Religion,

(2) the extent to which participants in the program believe that the Institute of Religion accomplishes these objectives for its students, and (3) the techniques that directors and teachers believe to be most effective in promoting these objectives and developments in students.

Minutes of the General Church Board of Education meetings from 1927 to 1957 and printed bulletins and circular letters issued by the church Department of Education were examined for all references to Institute objectives. Two questionnaires were developed, one for the professional teaching staff in the Institute program and the second for students. Each group was asked to evaluate the work of the Institute in terms of the objectives listed in the questionnaire and the extent to which they believed the Institutes were effectively accomplishing these objectives. Teachers were asked to evaluate the techniques being used to achieve these accomplishments.

Findings. (1) In general, the basic objectives of the Institute program having direct Latter-day Saint connotations were considered to be of utmost importance. Objectives which were largely secular in connotation tended to receive comparatively lower evaluation. (2) There was wide distribution of the techniques used to achieve the objectives of the Institute, no one technique receiving a substantial majority. (3) Faculty groups reported considerable personal inadequacies with respect to their ability to implement several of the Institute objectives. The prime weaknesses were reported in the areas of personal skills and appreciations. (4) The training of Institute personnel in basic and specific objectives was suggested most often by faculty groups as a means of improving the Institute programs. (5) Both the faculty and student groups suggested greater emphasis on the "doing" phases of the Institute curriculum.

Conclusions. (1) Since the establishment of the first Institute of Religion in 1927, church authorities have demonstrated a continuous and strong support of the Institute program. (2) There is general agreement among student and faculty groups concerning the importance of the basic objectives. (3) Institute teachers and directors do not agree on what constitutes the best manner to achieve the objectives of the program. (4) Many of the objectives that relate to the accomplishment and development of personal skills and appreciations are not thoroughly understood by Institute students and faculty. The result is that methods needed to carry out these objectives are not being applied effectively. (5) Teachers tend to use the traditional approach in their technique rather than to develop new methods or to create new ideas that will enable them to achieve a greater amount of success. (6) Most of the inadequacies in teacher techniques are related to areas of personal skills and appreciations. (7) Students tend to understand and achieve more in areas where an activity technique has been employed.

Recommendations. The following recommendations are made on the basis of the findings and conclusions. (1) A statement of the objectives of the Institute of Religion should be prepared by the church Department of Education and given to all personnel in the program on an instructional basis. (2) Teaching techniques which have as their prime motive the activity phase should be used more extensively in the areas of personal skills and appreciations. (3) Greater emphasis should be given by Institute teachers to basic objectives that are secular in nature. (4) Greater emphasis should be given by the Department of Education and Institute personnel to the field of scholarly research as it relates to the training and education of students. (5) The church Department of Education should study the problem of scholastic standards in the Institute of Religion and inaugurate a program that will raise the over-all requirements and quality of instruction. (6) In the selection of future Institute personnel, careful attention should be given to candidates' understanding and concept of the fundamentals of Mormon doctrine and philosophy, which relate to the role of the Church in world-oriented action.

Microfilm $5.15; Xerox $18.20. 401 pages.

FRINGE BENEFITS FOR CLASSIFIED EMPLOYEES OF LARGE-CITY SCHOOL DISTRICTS

(L. C. Card No. Mic 59-4387)

Edgar Carl Egly, Ed.D.
University of Southern California, 1959

Chairman: Professor Nelson

The purpose of the study was (1) to undertake an investigation of personnel practices of public school districts in cities of 100,000 or more population with respect to the granting of fringe benefits to classified employees, (2) to develop a list of principles to serve as criteria for the evaluation of public school district policies concerning fringe benefits, and (3) to compare the practices of public schools with business, industry, and municipal government.

Questionnaires were submitted to the 109 public school districts in cities of 100,000 or more located in the United States and 86.2 per cent were returned. In addition, a reaction panel of twenty specialists was utilized to evaluate the policies and practices under study.

Findings. Some forty specific findings were presented in this study. Typical of these are: (1) The majority of office employees included in the Bureau of Labor Statistics Survey were covered by hospital and surgical insurance. About half of these office employees were covered by medical insurance. In contrast, only three of the school districts surveyed in this study provided a program of hospital, medical, and surgical insurance to their classified employees. (2) The modal vacation allowance for all districts from the first to the tenth year of employment was ten working days per year; from the eleventh year to the twenty-fifth year the modal vacation allowance was fifteen days per year.

Conclusions. (1) The granting of fringe benefits is a nationally accepted practice in school districts as well as in business and industry. (2) Measured in terms of the criteria established for this investigation, many school districts are performing acceptably in most areas of fringe benefit practices. (3) The practices of school districts in granting fringe benefits vary widely. Some grant very few benefits, while others provide extensive fringe benefits. (4) The range and amount of fringe benefits provided by school districts tend to increase proportionally with the size of the city in which the school district is located. (5) The schools located in cities in the western part of the nation provide more extensive fringe benefits than do schools located in other sections. (6) Office employees in business and industry have a broader benefit program

for retirement plans, life, hospitalization, medical and surgical insurance than do the classified employees of school districts.

Recommendations. (1) Employees should be permitted to arrange for a payroll deduction for group health and accident plans when none is provided by the school. (2) Extreme care should be used in adding new benefits or extending old ones, since it is exceedingly difficult to reduce or eliminate one already granted. (3) Studies should be made which clearly define the goals to be achieved through the granting of fringe benefits, and should determine how well present programs are achieving these goals. (4) Fringe benefits should not be granted at the expense of adequate wages and salaries. (5) The trend in fringe benefits should be toward providing insurance coverage for catastrophic incidents. Fifteen additional recommendations are listed in this study. Microfilm $3.45; Xerox $11.60. 265 pages.

AN ECONOMIC INDEX OF COUNTY ABILITY TO SUPPORT EDUCATION IN MICHIGAN

(L. C. Card No. Mic 59-4701)

Willard Fox, Ed.D.
Wayne State University, 1959

Adviser: W. Ray Smittle

This study was founded on the belief that property tax is not as valid a measure, as it once was, for determining the ability of school districts to support education and the concomitant relative right of school districts to share in the proceeds of state allocated funds. It was the premise of this study that a more equitable measure of the relative ability of Michigan school districts to support an educational program is dependent upon many factors in the total economy of the school districts and the state.

The states of Alabama, Florida, Texas, Georgia, Arkansas, Mississippi and Tennessee have developed and used combinations of economic factors to determine the ability of school districts to support an educational program. The combination of economic factors used to determine the relative shares school districts receive of state aid is called an economic index. A review of the literature of the field and statutes of the above mentioned states led to the assumption that an economic index to measure the relative ability of the counties of Michigan was feasible. The study is a result of this assumption.

The need for the study was pointed up by an analysis of the program for local and state support of education in Michigan with special attention paid to existing inequities. The inequities considered were in the area of original assessments; assessments of different types of property; diversification of wealth; concentration of wealth; inflation; and property escaping taxation.

Factors included in the economic index were selected in accordance with criteria adapted from criteria used in other states and by authorities in the field. The economic factors selected to be combined and used as an index of ability were: retail sales tax collections by counties; business activities tax receipts by counties; intangible tax collections by counties; motor vehicle fees paid by counties; and the value of farm products sold by counties. Each factor was computed in terms of each county's percentage of the state total.

The problem of weighting the factors within the index was solved by empirical means. The weights used by the states of Alabama, Florida, Texas, Georgia, Arkansas, Mississippi and Tennessee were considered as guide posts in weight assignment as was the degree of best fit. The degree best fit was considered in the light of first-hand knowledge of the diversity of ability among counties of the state. Diversities of wealth concentration, wealth sparsity and assessment ratios were considered. An additional element considered in weight assignment was an effort to recognize the significance of various factors in the total economy of the state of Michigan. The weights assigned were: retail sales tax collections 45; business activity tax receipts 5; intangible tax collections 5; motor vehicle fees paid 35; and value of farm productions sold 10. All five factors were put through a formula to arrive at an indication of the relative ability of Michigan's 83 counties to support an educational program. The resultant economic index was then compared to the measure of ability currently in use in Michigan. Of the 83 counties in Michigan, 20 did not show as much ability as they are currently purported to have. Sixty-three counties show greater ability.

In order to implement the use of the county economic index on a local district level a method was devised which used a school district's percentage of the state equalized valuation of the county to determine its relative share of ability within the county. This figure was applied to the current procedure for allocating state aid to schools in order to evaluate the effect of the economic index when applied on a local district level. Seven counties were used to demonstrate the procedure.

Use of state equalized valuation as an instrument in the procedure invalidates, to some extent, the advantages gained by using an economic index rather than property valuation as an ability element in the state aid formula. It provides the circumstance of making the advantage gained by underassessment in one district fall upon other districts in the same county rather than on some district far away. Microfilm $2.85; Xerox $9.80. 217 pages.

THE DEVELOPMENT OF A STATE LEVEL POLICY IN SCHOOL DISTRICT REORGANIZATION

(L. C. Card No. Mic 59-4367)

Lester William Hunt, Ed.D.
The University of Nebraska Teachers College, 1959

Adviser: Merle A. Stoneman

The Purpose and Procedure of the Study

The purpose of this study has been to identify the characteristics of policy under which the State Committee for Reorganization of School Districts in Nebraska has considered the many proposals for changes in district boundary lines which have come before it. To arrive at the identification of this policy, it was necessary to examine the progress made in reorganization of school districts during the nine years since the State Committee was formed

and to evaluate the progress made according to standards recommended by authorities, and further to examine the recommendations made by the State Committee concerning the plans by which the progress was made and which were presented to the Committee for consideration. Procedures used:

1. Historical research into the official minutes of the State Committee for Reorganization of School Districts, and to a minor extent, into the records of the county committees;
2. Compilation, from records of the State Department of Education, statistical data concerning the progress of school district reorganization since 1949;
3. Questionnaires sent to county superintendents, and to members of the State Committee to secure opinions; and
4. Interviews with selected individual members of county committees, of the State Committee, and of the State Department of Education.

Major Conclusions

This study concurs with studies reported in the literature which have shown that there are many factors which help or hinder the achievement of adequate organization of school districts. It has shown that the State Committee for Reorganization of School districts has developed a policy, or set of principles under which to consider plans presented to the committee. Further conclusions reached:

1. Nebraska statutes allow the State Committee for Reorganization of School Districts to perform only part of the function which it should serve;
2. Reorganization which has taken place in Nebraska has achieved only a part of the goal of efforts to form adequate districts;
3. More assistance and information need to be given to lay and professional leadership in local communities and to county committees; and
4. Nebraska's financial support for schools is not conducive to adequate reorganization of school districts.

Recommendations

1. Provide legislation to require the organization of all land in Nebraska into K-12 districts capable of providing a comprehensive program for all children, with a latest date of the completion thereof;
2. Provide for a state-wide study and plan for reorganization of school districts with assistance given to the State Committee to make such a study;
3. Define more clearly the authority of the State Board of Education to approve high schools in Nebraska;
4. Adopt sources of revenue to equalize school support, and distribute the proceeds so as to encourage reorganization;
5. Encourage the development of sound professional positions among the educators in the state in regard to issues affecting reorganization; and
6. Give the State Committee authority to approve or disapprove all plans for reorganization of school districts, such approval to be based upon the determination of the extent to which the proposed district accomplishes the maximum possible improvement in the particular area in which it is located.

Microfilm $5.25; Xerox $18.40. 410 pages.

AN ANALYSIS OF THE POLAR ORIENTATIONS OF EDUCATIONAL ADMINISTRATION AND THEIR IMPLICATIONS FOR EDUCATIONAL LEADERSHIP

(L. C. Card No. Mic 59-4939)

Jongchol Kim, Ph.D.
University of Michigan, 1959

The study was undertaken to meet the general need for a theoretical and interdisciplinary approach to the study of educational administration on one hand, and to meet the particular need on the part of the writer for preparing a theoretical frame of reference to interpret the fundamental concept of democratic educational administration and democratic educational leadership on the other hand. Thus the study attempted to clarify the concept of democratic educational administration and educational leadership in terms of a conceptual analysis of the polar orientations of educational administration, i.e., the institutional approach versus the human relations approach to educational administration.

The major procedure of the study consisted of the usual steps involved in the scientific method of philosophical or historical research in general, employing the inductive method. The theorization necessarily involved the deductive method, however. Because of the macroscopic nature of the study and the interdisciplinary approach to the study, not only theoretical writings but also philosophical works in various fields of education and social sciences were broadly utilized for the study.

The study was organized into five major steps. An analysis of the polar concepts of education in terms of the socially-oriented concept of education versus the individually-oriented concept of education was the first step. It was the preliminary step to clarify the philosophical presuppositions of the study. The second step of the study was concerned with a global overview of the polar orientations of educational administration, and further with an analysis of the theoretical foundations of the polar orientations of educational administration. The theory of bureaucracy, the scientific management theory, and the administrative theory stressing the organizational principles were reviewed and analyzed as the theoretical foundations of the institutional approach, while, on the other hand, the theory of informal organization, the group dynamics theory, and the theories of behavior and personality stressing the human adjustment point of view were suggested as the theoretical foundations of the human relations approach. The third step of the study consisted of an analysis of the value assumptions underlying the polar orientations of educational administration. Ten pairs of value assumptions in regard to the ends, means, modes of administration, and leadership style were explicated. The fourth step of the study was concerned with a review of twelve current theories of educational administration and administration in general, classified under eight categories. They were

evaluated in relation to the polar orientations of educational administration. The final step of the study consisted of an evaluation of the polar orientations of educational administration and a proposal for an integrative concept of educational administration in terms of a series of twelve propositions.

In brief, on the basis of review, analysis, and evaluation of 1) the polar concepts of education, 2) the theoretical foundations and value assumptions of the polar orientations of educational administration, and 3) the major current theories of educational administration and administration in general, the study concluded: just as neither the socially-oriented nor the individually-oriented concept of education is tenable as a concept of democratic education, so neither the institutional approach nor the human relations approach is tenable as a concept of democratic educational administration. And in parallel with the integrative concept of education suited for a democratic society, an integrative concept of educational administration stressing the balance between, and integration of, the institutional approach and the human relations approach was proposed in a broad theoretical context.

Microfilm $3.95; Xerox $13.40. 306 pages.

IMPLICATIONS FOR PUBLIC EDUCATION IN PENNSYLVANIA RESULTING FROM FEDERAL CONTROL IN CERTAIN SUBSIDIZED PROGRAMS

(L. C. Card No. Mic 59-5114)

Charles Daniel Leach, Ed.D.
The Pennsylvania State University, 1959

It was the primary objective of this study to investigate the controls which regulate federal aid for vocational education and for schools in federally affected areas, and to identify the implications of these controls for public education in Pennsylvania. Specifically, the problem was to: (1) determine the nature and extent of the legislative and administrative controls exercised by the federal government over these important educational activities in Pennsylvania; (2) determine the implications of these controls by identifying the reactions on the state and local levels in modifying or establishing programs which conform to the federal requirements; (3) analyze these implications to determine the effect of the federal controls over subsidized programs on the overall educational program in Pennsylvania; and (4) make recommendations for state policy regarding federal grants for public education.

This study was primarily historical and descriptive. The federal laws and regulations relating to vocational education and assistance for districts in federally affected areas were located and studied. The history of these laws and regulations and of other forms of federal aid for education was investigated to permit a more comprehensive interpretation of their provisions. The school laws of Pennsylvania were studied to determine the reactions of the Pennsylvania legislature to the federal legislation. The publications of the Pennsylvania State Department of Public Instruction were reviewed and state employees were interviewed in the search for evidence of reaction to federal controls over the subsidized programs in Pennsylvania. The related literature was studied and comparable investigations reported to further substantiate the findings of this study. The major sources of data were the publications of federal laws and regulations, the Pennsylvania School Laws, the bulletins of the Pennsylvania Department of Public Instruction dealing with the various vocational curricula, and the related publications of the United States Office of Education.

The program of assistance for federally related districts was found to have important restrictions only with regard to the use of federal funds for school construction. Single-purpose auditoriums, gymnasiums, and lunchrooms, may not be constructed with federal funds. There was no evidence discovered that these restrictions have affected public education in Pennsylvania.

The program of federal aid for vocational education contains many restrictions and conditions which have influenced public education in Pennsylvania far out of proportion to the amount of federal aid actually provided. Evidence of this influence was noted with respect to personnel, school buildings and facilities, and program of studies. The influence was observed at both state and local levels. The Congress had a clear conception of the type of vocational education which it desired to promote, and the program in Pennsylvania was developed in complete conformity with the federal intent. Federal aid for vocational education amounts to less than one per cent of the total expenditures for education in Pennsylvania, but it has influenced the entire structure of public education throughout the state.

It is recommended that the state reappraise vocational education in Pennsylvania to determine if the curricular imbalance which now exists can be justified on the basis of the small amount of federal aid received for this program. It is recommended that federal aid programs proposed in the future be studied by state authorities to determine if state influence should be used to promote or to discourage the legislation. It is recommended that the Pennsylvania Act of May 11, 1949 (Section 2907 of the School Laws of Pennsylvania) which authorizes, directs, and empowers the Superintendent of Public Instruction to comply with all requirements of future federal aid legislation not inconsistent with state laws, be reconsidered and, if necessary, amended.

The assistance granted districts in federally affected areas indicates that federal aid can be provided with a minimum of control. Federal aid for vocational education demonstrates that conditional grants can exert a disproportionate influence on public education in Pennsylvania.

Microfilm $3.60; Xerox $12.20. 280 pages.

SOME ASPECTS OF COMMUNITY SERVICE PROGRAMS IN SEVENTEEN COLLEGES AND UNIVERSITIES IN THE UNITED STATES

(L. C. Card No. Mic 59-4730)

John Brown Murphy, Ph.D.
The University of Texas, 1959

Supervisor: Dr. James W. Reynolds

This study is concerned with the determination of current trends relating to certain aspects of the administration

of community service programs in seventeen colleges and universities in the United States. Interviews held at each of the seventeen institutions with officials for the administration of the community service program together with printed materials from each of the institutions furnished the data used in determining trends. The aspects of community service programs which were considered in determining trends were: (1) the organization for administration and instruction within each institution, (2) the participation of adult students, and (3) the curriculum of community service programs.

The administration of community services is regarded by the majority of colleges and universities as a major division or unit of the institution. There appeared to be a definite trend toward the participation by a greater proportion of the faculty in the community service programs. The organizational patterns for achieving coordination between the administration of the community service function and other college and university functions varied from one institution to another. However, it was apparent that although this function requires flexibility of administrative practice, each institution can be guided by common practices and principles of good organization. Examples of these are: the establishment of definite lines of authority, definite, written policies of procedure relating to all foreseeable conditions that apply to working relations of personnel, organization of activities, and student participation.

The proportion of adults who engage in college and university programs of non-credit educational activities appears relatively small as compared to the total adult population, but the indications are that the proportion is steadily increasing. The voluntary nature of adult participation appears to be its most important limitation, although the size and economic dynamics of the community itself are important factors in considerations of either present or potential participation.

It was quite evident that publicity techniques associated with community service offerings differ significantly from those used for the formal college and university offerings. In most instances, personal contact by representatives of the institutions with persons having a potential interest was considered to be a most effective technique, although newspaper articles designed to emphasize the need for the importance of this type of training appeared to be another effective medium of publicity.

The general trend toward according community service programs a place of importance in the organization of colleges and universities has not often been accompanied by the same budgetary arrangement which exists for other phases of educational administrative activity. The basic reason for this difference appears to lie in the methods of distribution of state and federal funds for certain kinds of programs.

It is quite evident that there is great need for better systems of statistical records of community service activities in most colleges and universities as a means of strengthening research and of providing the basis for improvement of method, program, and administration.

The findings of the study warrant the following recommendations:

1. That the community services of colleges and universities remain on a voluntary basis, with the maximum amount of independence and integrity accorded to every institution.
2. That evaluative criteria for non-credit community service programs be formulated by the individual and joint efforts of interested agencies such as the United States Office of Education, the National University Extension Association, the Association of University Evening Colleges, and the American Association of Junior Colleges; and that closer supervision be exercised by regional accrediting agencies and state offices of education.
3. That physical facilities on campuses be increased for participants in adult education activities.
4. That the matter of the cost of providing adequate physical facilities for general adult education, especially as it relates to state colleges and universities, should be clarified.

Microfilm $3.40; Xerox $11.60. 262 pages.

THE MOVEMENT FOR REORGANIZATION OF ADMINISTRATIVE UNITS IN PENNSYLVANIA AND ITS EFFECTS ON THE PROGRAMS OF TWENTY SELECTED HIGH SCHOOLS

(L. C. Card No. Mic 59-5124)

Harris W. Reynolds, Ed.D.
The Pennsylvania State University, 1959

The Problem

The main problem of this study was to determine what changes have occurred in the educational programs of certain selected high schools, 1940 to 1958, as the result of the reorganization of the school districts in which they were located.

The elements of this main problem were treated as subproblems and auxiliary problems.

Problems considered were:

1. What relationship did area, population, pupil enrollment, and wealth bear to educational change?
2. How did the social, economic, and cultural patterns of the community aid or hinder the support of the school program?
3. Could the quality of the educational program be evaluated?
4. Did reorganization affect the quality of education?

Limitations

The problem was concerned with the secondary level only. Improvement of educational offerings was the central theme. Improvement was considered to be obtained by increased curriculum offerings and services. No attempt was made to evaluate the actual teaching situation except in considering the placement of the teacher in major or minor fields of certification.

Procedure

An instrument was constructed to determine the quality of school programs in operation. An interview questionnaire was constructed to gather information concerning community background. The respondent to the interview concerning quality of the school program was the high

school principal. The superintendent or supervising principal was the respondent concerning community background.

Data on selected schools were used in statistically determining correlations and in applying tests of significance of the difference of means by "t" tests.

Conclusions

Larger enrollment permits a more diversified and better balanced program of offerings.

Reorganization caused improvement in the educational program of schools in comparison to what existed before reorganization. Reorganized schools revealed a more rapid advance in program improvement.

The curriculum offerings of the high school have been broadened in the process of reorganization. The use of supplemental appropriations has secured more services and service personnel for the high school program.

Supplemental appropriations have been effective in promoting stronger and larger administrative districts as well as in promoting increased services and additional personnel.

Enrollment has a significant relationship to the quality score of the school program. This would tend to justify the elimination of the small high schools by the program of reorganization of administrative units.

Schools with better market value potential are more apt to desire a more comprehensive program and to be more willing to spend money to attain it.

The particular type of reorganization has little effect on the high school program. Wealth, general population and student enrollment, and community interest have a major effect on the high school program.

Microfilm $3.05; Xerox $10.60. 236 pages.

AN ANALYSIS OF LEGISLATIVE STATUTES, JUDICIAL DECISIONS, POLICIES, AND PRACTICES RELATED TO THE REVOCATION OF CERTIFICATION OF PUBLIC SCHOOL PERSONNEL

(L. C. Card No. Mic 59-4398)

Patrick Otis Rooney, Ed.D.
University of Southern California, 1959

Chairman: Professor Stoops

The purpose of this study was (1) to analyze and interpret the statutory provisions of the various states relating to the revocation of certification of public school personnel; (2) to review court cases and legal opinions pertaining to the revocation of teaching certificates; (3) to analyze the policies and opinions of the state superintendents, state boards of education, and state departments of education concerning the revocation of teacher certification; (4) to investigate the policies and practices of the professions of medicine and law relating to the revocation of medical and legal licenses; and (5) to establish criteria for the revocation of certification of undesirable school personnel.

Data were obtained from a review of related literature, an analysis of court cases, and the use of two questionnaires. The first questionnaire provided information concerning present revocation practices in the fifty states. The second questionnaire contained twenty-seven criteria related to the problem and was directed to members of the Reaction Panel.

Conclusions. (1) The difficulties encountered by the medical and legal professions as they strove for internal self-control were similar to those problems which are currently being facted by the profession of education. (2) The legislative statutes for the fifty states and the rules and regulations of the various revoking authorities indicate a serious lack of legislative provisions, written policies, rules, and regulations relating to the revocation of teaching certificates. (3) The review of the legislative statutes of the fifty states indicates that there is little consistency among the states with respect to legal provisions for the revocation of teacher certification. (4) The number of teaching certificates revoked by the various legal authorities is comparatively small when the incidence of revocation is viewed in terms of the large number of certified persons in the public schools of the United States. (5) The review of legislative statutes for the fifty states indicates that the trend is toward the vesting of revocation responsibilities in a centralized state agency or person. (6) The chief reasons for the revocation of a professional license are to safeguard the public from unfit and unethical personnel and to protect the honor and esteem of the members of the profession. (7) Research in the medical and legal fields, indicates that a more effective and comprehensive discipline is accomplished when disciplinary responsibilities are assumed by a professional organization.

Recommendations. (1) It is recommended that revocation responsibilities be removed from all local and intermediate authorities and be vested in the state board of education or other comparable centralized state agency. (2) State-wide educational organizations should seek more professional representation on the authorities with revocation responsibilities. (3) It is recommended that general as well as specific causes for the revocation of a teaching certificate be enumerated in the legislative statutes of the various states. (4) State-wide educational organizations should establish a Commission of Professional Ethics and Grievances to enforce ethical principles and professional standards. (5) To complement the activities of the Commission of Professional Ethics and Grievances, it is recommended that the Commission nominate panels of "auxiliary" Commissioners for each geographical division of the state. (6) The statutes of each state should (a) provide for the written notification of revocation charges, (b) guarantee each teacher an opportunity for a hearing before the revoking authority, (c) allow each teacher the right to legal counsel, (d) allow each teacher the opportunity to introduce evidence in his own behalf, (e) allow each teacher to present witnesses and to cross-examine witnesses appearing against him, (f) allow each teacher the right to appeal the decision of the revoking authority, and (g) contain provisions for the reinstatement of a revoked certificate.

Microfilm $5.40; Xerox $19.00. 424 pages.

THE DEVELOPMENT AND UTILIZATION OF A PROCEDURE FOR APPRAISING THE COMPETENCY OF EDUCATIONAL ADMINISTRATION STUDENTS AT GEORGE PEABODY COLLEGE FOR TEACHERS

(L. C. Card No. Mic 59-1120)

John Waits Teel, Ed.D.
George Peabody College for Teachers, 1958

Major Professor: Erick L. Lindman

The purpose of this study was to develop and experiment with the utilization of a procedure for appraising competency in educational administration at George Peabody College for Teachers. The procedure was based upon a series of situational tests designed to require of the student in educational administration competencies similar to those required by actual administrative tasks. The situational tests utilized were: (1) leaderless group discussion, (2) assigned leadership role, (3) impromptu speech, and (4) reply to letter. The observed behavior of seventeen advanced graduate students in educational administration was evaluated by ten members of the George Peabody College for Teachers Department of Education and three practicing administrators.

The performance ratings of the students on the situational tests were statistically compared with their scores obtained on several psychological tests. The psychological tests utilized were: (1) Allport-Vernon Study of Values, (2) Minnesota Teacher Attitude Inventory, (3) Watson-Glaser Critical Thinking Appraisal, (4) Sims SCI Occupational Rating Scale, (5) Edwards Personal Preference Schedule, (6) Cooperative English Test, (7) Cooperative General Culture Test, and (8) Miller Analogies Test. The grade point average for each student participating in the study for certain courses in educational administration was computed and used in the comparison.

Conclusions

The findings of the study appear to support the following conclusions:

1. The interest and enthusiasm of faculty members and students in educational administration shown toward the development and utilization of the procedure indicate a need for such projects.
2. A study of the relationship between the performance ratings of the students on the situational tests and scores obtained on the psychological tests tended to support the theory that situational tests may be useful as a final procedure in selecting and appraising the competency of students in educational administration.
3. The situational testing program revealed that from the standpoint of ease of administration and interest of the participants, the leaderless group discussion is the most promising of the situational testing techniques employed.
4. This exploration of the situational testing technique as a method for appraising competency in educational administration has led to the formation of hypotheses for further investigation.

Microfilm $2.00; Xerox $6.60. 137 pages.

THE OPINIONS OF SUPERINTENDENTS OF SCHOOLS AND PROFESSORS OF EDUCATION CONCERNING INTERNSHIPS IN EDUCATIONAL ADMINISTRATION AS RELATED TO COMPETENCIES NEEDED BY SUPERINTENDENTS OF SCHOOLS

(L. C. Card No. Mic 59-3368)

Elbert Truman Wester, Ed.D.
The University of Oklahoma, 1959

Major Professor: Claude Kelley

Internships in educational administration have been almost wholly a development of the past twelve years. Most studies of educational internships have been of the status type designed to determine existing practices, procedures, and policies. This dissertation has attempted to determine the opinions of a selected group of superintendents of schools and professors of education regarding the value of internships in the learning of competencies needed by superintendents of schools.

The first part of the dissertation sought to find the relatively most important competencies needed by superintendents of schools. By a documentary frequency count using books and periodicals published during the eleven year period from 1946 to 1956, a list of 167 competencies, with their frequency of mention, was determined. This list of competencies needed by superintendents of schools was reduced to a list of 114 competencies by combining two or more competencies into a more general competency. This list was then interrelated with lists of competencies determined by the Southern States Cooperative Program in Education Administration, the Southwest Cooperative Program in Educational Administration, the National Conference of Professors of Educational Administration, and the Cooperative Study of Secondary-School Standards. A list of the fifty relatively most important competencies needed by superintendents of schools was determined.

Ratings were determined for each of the fifty competencies considered. In the top list of competencies, the three following competencies were found: Working with the Board of Education in the Formulation of Public School Policy and Plans; Selecting and Assigning Staff Personnel; and Organizing Lay and Professional Groups for Participation in Educational Planning. In the second highest group of competencies were found the following: Providing for Curriculum Development; Providing Instructional Leadership; Preparing the Budget for the School District; and Providing for Group Planning and Decisions.

Questionnaires were completed by 143 superintendents of schools and 178 professors of education on which they rated the relative rank of four experience areas for best learning the fifty competencies. These four experience areas were previous administrative experience, courses in education and related fields, internship, and classroom teaching.

According to the opinions of professors, the experience areas were rated in the order of previous administrative experience, courses in education and related fields, internship, and classroom teaching for best learning the fifty competencies. For superintendents of schools, the order was previous administrative experience, internship, courses in education and related fields, and classroom teaching.

For the entire group of respondents, internship was rated below previous administrative experience and courses

in education and related fields as an experience area for best learning the competencies needed by superintendents of schools. Microfilm $2.30; Xerox $8.20. 176 pages.

ORIENTATION AND IN-SERVICE EDUCATION OF TEACHERS IN SECOND AND THIRD CLASS SCHOOL SYSTEMS OF PENNSYLVANIA

(L. C. Card No. Mic 59-5133)

Herman Dale Winger, Ed.D.
The Pennsylvania State University, 1959

This was a study of certain practices used in teacher orientation and in-service education, and an evaluation of these practices in terms of criteria established through the literature and by consultation with authorities in the field. The study group consisted of all the second and third class school systems of the Commonwealth of Pennsylvania.

Data for the study were obtained through a pilot study, interviews, and a questionnaire prepared from the literature and supplemented by information gained from the pilot study.

The data obtained were evaluated in terms of the class of the school district and the amount of supervision available in the district. Comparisons were made using these data to indicate relative strengths and weaknesses of teacher orientation and in-service education programs in two types of school district.

From the data presented in the study it was possible to form the following conclusions regarding orientation and in-service education programs for teachers.

1. Teacher orientation programs are based primarily upon clerical and minor administrative duties which must be performed by teachers, and are not adequately preparing the new teacher for his classroom duties. Orientation programs do not begin soon enough and do not continue long enough to prepare the new teacher for his many responsibilities in the classroom.

2. Teacher orientation and in-service education programs in second and third class school systems of Pennsylvania are seldom related to one another. These programs do not supplement each other as theory indicates they should, and in many cases little attempt is made to plan them in such a manner that they best serve the needs of teachers.

3. In-service education programs are primarily instruction centered and place major emphasis upon practical problems facing the classroom teacher. Teachers and administrators feel that in-service education programs do much to improve the quality of classroom instruction.

4. Subject matter preparation of teachers and teaching methods need to be given additional emphasis in the in-service education programs for teachers. These are areas where teachers and administrators feel much needs to be done to strengthen in-service education in Pennsylvania.

5. The evaluation of teacher orientation and in-service education programs is a major problem as indicated by data presented in the study. Respondents to the study indicated that they were not satisfied that evaluative techniques were adequate or effective.

6. The lack of sufficient funds to operate orientation and in-service education programs, and effective leadership in planning and directing them, were two major problems indicated by data presented in this study. Financial support was inadequate and poorly planned. Most respondents indicated that there needs to be a staff member specifically assigned to teacher orientation and in-service education to assist in planning and executing the programs.

This study indicated that school authorities regard teacher orientation and in-service education programs as valuable and necessary to the school program. Respondents stated that due to inadequate preparation of teachers, both programs will expand in future years, but they also expressed the feeling that the programs must be made much more effective.

Microfilm $2.00; Xerox $5.40. 110 pages.

EDUCATION, ADULT

CRITERIA FOR EVALUATION OF ADULT EDUCATION PROGRAMS IN JUNIOR COLLEGES AND THEIR APPLICATION TO KILGORE COLLEGE

(L. C. Card No. Mic 59-4760)

Leland Beyer Luchsinger, Ed.D.
The University of Texas, 1959

Supervisor: Dr. C. C. Colvert

A review of the history and development of the junior college, and of the adult education movement was made to show the evolution of adult education as a function of junior colleges. Previous studies of adult education were studied to determine if any criteria had been established for analysing an adult education program in a junior college. There were no criteria available.

Data were received in response to a questionnaire from one hundred and twenty-four junior colleges, located in thirty-two states. These data were analysed and compiled in five general classifications: adult enrollment; adult student personnel services; administration of the adult education program, which included organization, administration, publicizing, and financing of the adult program; the position of adult administrator and staff; and instructional practices and procedures and curricula in junior colleges. These data were used in producing sixty-five tables and thirty graphs. The information which was used to compile the tables and graphs revealed acceptable procedures which were practiced in adult education programs in the responding junior colleges.

The common practices which were used by junior colleges served as the basis for creating criteria composed of six major divisions, with from three to twelve statements in each division. There were a total of forty-four statements in the criteria which could be rated as unsatisfactory, poor, fair, good, or excellent. The statements to be rated were based upon data given in response to the questionnaire. Responses were tabulated and tables were made. The information revealed in a table was used as follows: the range was used for the unsatisfactory and excellent ratings; the median was used for the rating of fair; and the first and third quartiles were used for the

ratings of poor and good respectively. These criteria can be used to analyse and evaluate an adult education program in any junior college.

After the criteria were drawn up, they were used by three administrators, sixteen instructors, and seventy-eight adult students to analyse and rate the adult education program of Kilgore College.

The study resulted in the following recommendations for improving the Kilgore College program: (1) adult enrollment will be increased when advisory committees are appointed and used; (2) the guidance service rendered to adults must be made available at a more convenient time; (3) the philosophy of the program should be based on the consensus of a representative group of administrators, instructors, and lay persons; (4) the library should be open the nights classes are conducted; (5) the administrators must continuously receive the opinions of the instructors and adult students in order to evaluate the program objectively; administrators should not rely on their opinions of what they think is being done.

Microfilm $4.60; Xerox $15.40. 357 pages.

EDUCATION, HISTORY

CATHOLIC REACTION TO AMERICAN PUBLIC EDUCATION, 1792-1852

(L. C. Card No. Mic 59-3658)

Jerome Edward Diffley, O.S.B., Ph.D.
University of Notre Dame, 1959

This study, The Catholic Reaction to American Public Education, 1792-1852, centers around three features in the origin and early development of Catholic parochial elementary schools in the United States. The official statements of the American bishops embodied in the Pastoral Letters and decrees of the first seven Provincial Councils and the first Plenary Council of Baltimore give evidence that Catholics were increasingly dissatisfied with conditions in the existing and awakening public schools. Specifically the objections pointed to two factors prevalent in the public schools which made them unacceptable to Catholics. These were the Protestant nature of and activities in public education and the philosophy of liberalism that was prevading American thought. Very strong terms were used in reference to these features of public education in the official statements issued by the Fourth Provincial Council of Baltimore (1840). These constituted the strongest expressions of dissatisfaction and most decisive tones adopted by Catholic statesmen thus far. The third feature considered was the rapid upsurge of Catholic schools after these statements in 1840.

The alleged Protestant nature of public education was investigated along the lines of personnel in influential official positions, the text-books in use, and the extent to which the King James version of the Bible was used for all children, Protestant and Catholic alike. The teachers' associations that were forming and the training institutes were found to be largely under Protestant ministerial control. Extensive use was made of state educational Reports from the chief school officers in Massachusetts, Connecticut, Maine, New York, Ohio, Indiana, New Jersey, Michigan, and New Hampshire. Educational journals of the period were also found useful. Generally the Catholic bishops allegations of the Protestant nature of public education were found to be amply justified.

The philosophical principles that Catholic bishops claimed were irreconcilable with their own were investigated. The term liberalism was considered to be generic and included specific reference to rationalism in knowledge, naturalism in religion, and an exaggerated humanitarianism in social action. The writings of John Locke, Jean Jacques Rousseau, Thomas Paine, and, especially Johann Pestalozzi gave sufficient proof that principles unacceptable to Catholics were part of the philosophy of liberalism. The principles were applied to education and came to this country through American educational "observers" in European countries. Henry Barnard, Victor Cousin, Calvin Stowe, Alexander Bache, and Horace Mann were the principal ones who disseminated European educational practices based on the liberalism to which Catholics objected. Catholic bishops, particularly John Carroll, John England, Simon Bruté, and John Hughes recognized and reacted against this philosophy in American circles.

The positive portion of the study looked to the bishops' decision to establish their own schools and the implementation of this decision. Their strongest reaction to public education was voiced in 1840. Concerted efforts to found parochial schools as a diocesan policy were evident in the Catholic Directories from 1833 to 1860, but especially after 1840. Most of the information for these Directories was submitted by the bishops themselves, so this evidenced their personal attempts to implement the 1840 decision in their dioceses. The United States Catholic Miscellany, a Charleston paper, was particularly helpful because of its timeliness and reprints from other papers not available to the investigator. The wide geographical area covered, the pastorals reprinted, the synodal decrees and attitudes toward education, both public and Catholic, reported in this paper gave access to national and international views on the subject.

Briefly stated, other conclusions of this work not evident in the preceding description may be summarized thus:

1) The American Catholic school system is unique in the general church discipline.

2) The Catholic leaders' decision to establish their own schools was motivated by a commitment to strive for the eternal salvation of their charges without allowing temporal considerations to predominate.

3) By the First Plenary Council of Baltimore (1852) many dioceses were acting on the parochial school regulation then enacted.

4) The educational decrees of the Third Plenary Council of Baltimore (1884) were the culmination of forces that had been operating in American Catholic life since it was organized under Bishop Carroll in 1789.

Microfilm $4.55; Xerox $15.20. 354 pages.

A SEMANTIC STUDY OF SELECTED SUPPLEMENTARY READERS USED IN THE PRIMARY GRADES

(L. C. Card No. Mic 59-4451)

Charles Dunseth Groff, Ed.D.
University of Pittsburgh, 1959

The purpose of the study was to determine the variation in word meaning of the vocabulary as used in selected supplementary reading books published for use in the primary grades. The normative type of research was used.

The grade placement of the books was determined by the application of the Spache Readability Formula. In making the semantic count each word was recorded on a five-by-eight-inch card. The Thorndike Word Book of 20,000 Words was used as the basis in determining what constituted a word. The phrase or part of a sentence necessary to show the meaning of a word in its context was copied. These were checked carefully in Webster's New International Dictionary, Second Edition, Unabridged.

A total of 17 books were selected for the study. They included The Cowboy Sam Series, The American Adventure Series, and six supplementary reading books that parallel the basic readers published by the Scott-Foresman Company and the Macmillan Company.

Of the books sampled the grade placement by the publishers was found to be in close agreement with that determined by the application of the Spache Technique. Twelve of the books showed a variation up to nine-tenths of a year.

In making the semantic count 4,101 words were recorded. Of this number 2,136 or 52 per cent of the vocabulary had from two to 39 different meanings per word. The word up had the greatest number of meanings in two of the series while the word in with 14 different meanings appeared the greatest number of times in The Cowboy Sam Books. The variation in word meaning occurring most often was the change from one part of speech to another or from the singular to the plural. Some words shifted from the literal to the figurative meaning while others, such as bear, to carry, and bear, the animal, had practically no similarity in meaning because of the different root word from which they have been derived.

The index number assigned by Thorndike was used as an indication of the difficulty of the vocabulary. In this respect very few words were used that are not familiar to children of the primary grades. A total of five per cent of the words with multiple meaning were assigned an index number of five or above while one per cent of the vocabulary was not listed in Thorndike's Word Book.

Conclusions and recommendations of the study are:

Semantics may present a real problem to the teachers of reading. At the primary level many words were used with multiple meaning and children must be made aware of the varied meanings of words or they may become confused and find trouble in learning to read.

The readability formula alone is not adequate in determining the difficulty of reading material. The problem of semantics must be taken into consideration when determining the difficulty of reading material.

Additional studies should be made to determine what confusion may arise in a child's mind when he encounters words with varied shades of meaning.

Teachers should undertake semantic investigations of materials they use in their classrooms so as to prevent confusion in the minds of their pupils.

Teachers should familarize themselves with research studies and articles on semantics so as to be aware of difficulties encountered by children.

Studies should be made to determine what difficulty a child encounters when he meets words with multiple meaning.

Authors of primary grade reading material should maintain better control over the meaning of words in context so that children do not encounter so many words with multiple meaning.

Microfilm $5.40; Xerox $19.00. 423 pages.

A HISTORY OF THE HIGH SCHOOL-COLLEGE RELATIONS COMMITTEE IN OREGON

(L. C. Card No. Mic 59-4319)

Francis B. Nickerson, Ed.D.
University of Oregon, 1959

Adviser: Miles C. Romney

The formation of the High School-College Relations Committee was preceded by a long period when the need to increase enrollments in Oregon public higher education institutions stimulated fiercely competitive recruiting among them. High school students were exploited to their disadvantage and to the disruption of their school programs. Seeming to promise all things to all students, the college emissaries tended to obscure the actual offerings of their schools. When the Oregon state system of higher education was organized in 1931 under a single board, one early act was to halt the recruiting clamor by severing all contacts of state institutions of higher learning with secondary schools. Enrollments declined. Lack of information in the high schools about public colleges caused confusion. A good noncompetitive approach to high school contacts was sought by the secondary school principals and superintendents, the State Department of Education, and the state system of higher education. In March, 1934, the High School Contacts Committee, approved by the State Board and representative of all elements interested in the relations between secondary and public higher education, held its first meeting, beginning a period of twenty years in which the Committee established itself as an effective intermediary between public colleges and the high schools of Oregon.

The history of this Committee unfolds as a study of a capsulesize institution of social control, a microcosm of theory in action: the committee method of handling the interactions of contradictory and competitive interests. Here within the convenient limitations of a narrow field of activity can be traced the process of establishing corporate order out of separate and opposed groups. The growth of an instrument of social control can here be thrown into clarifying perspective.

In common with other more complex social institutions this one sometimes failed in its assigned purposes because of circumstance or human limitation. Undeniably, however, the Committee has known more success than failure in establishing an orderly channel for the discussion and settlement of friction which in an earlier day festered between educational units lacking a common meeting ground.

As in other social instruments in any dynamic society, each problem solved by the Committee opened a new gate to confront them with larger issues. As the state schools grew more complex, so did the causes of friction among them increase. As research and experience changed patterns of conduct for secondary and higher education, the nature of the Committee's work had to change. This history discloses the flexibility of the committee system when administered by intelligent and reasonable men.

Specifically, the Committee has exerted control over visits of high school students to college campuses, the administration of the state fee scholarship program, and the publications used by the state system and its institutions in disseminating information to high school students and the general public. It has also influenced admissions policy and other such periodic problems as have created need for a discussion forum between secondary and higher education.

A wealth of material was available. With one exception all the leading people in the history are still active. The files of the State Board, the Principals' Association, the Committee itself, and newspapers, plus the published histories of the University of Oregon and of the organization of the Oregon state system of higher education, have provided ample records for a detailed analysis of the events involved.

Microfilm $3.70; Xerox $12.60. 288 pages.

EDUCATION, PHYSICAL

AN ANALYSIS AND EVALUATION OF HEALTH EXPECTANCIES OF FIRST GRADE CHILDREN

(L. C. Card No. Mic 59-3504)

Glenn W. Arnett, Ed.D.
University of Southern California, 1959

Chairman: Professor Davis

The problem of this study was to determine the appropriateness of the health expectancies which are commonly included in the health instruction program for first grade children—these health expectancies being the desirable, reasonable outcomes of health teaching based upon desired health behavior. The purposes of this study were to find out if behaviors of children upon entering the first grade met the expectancies held for them by health textbooks and courses of study, to find out if the content of current health textbooks and courses of study, in the form of expectancies, actually met the health instruction needs of first grade children, to find out areas of agreement and disagreement among experts, teachers, and parents with respect to the importance of presently held health expectancies for first grade children, and to use the three foregoing kinds of information as a basis for curriculum recommendations. The study was limited to seven public elementary school districts of San Diego County, California.

Data were secured from four populations. Three populations—the jury, teachers, and parents—were on the adult level, while the fourth population was the first grade children. A questionnaire-type instrument was used for gathering the reactions of the adult groups. Direct observation was selected for gaining information about the children. The health expectancies used in the questionnaires were determined from an analysis of current elementary health textbooks and courses of study in health instruction, and were selected because of their frequency of appearance. The 137 health expectancies used were grouped under 12 major health areas.

Findings. (1) Parents rated highly all the expectancies in each of the 12 health areas. The jury placed greater emphasis upon these same expectancies than did the teacher group. (2) The jury rated a far greater number of the 137 expectancies as being appropriate for the health instruction program than did the teacher group. (3) Ratings revealed that only about 60 per cent of the health expectancies would be considered worthy of inclusion in the health instruction program. (4) The parents' occupations showed little relationship to their ratings of the expectancies. (5) There was no discernible pattern of health behavior among the children of the seven occupational groups. (6) Over all, the jury seemed to have limited understanding of the health practices of first grade children. (7) The health category, according to the ratings of the three responding groups, needing greatest emphasis in the health instruction program for first grade was "Health Protection." The ratings placed least emphasis upon the category "Family, School and Community Health." (8) The factors relative to the respondent teachers' age, teaching experience, recency of graduation, and recency of having had a professional health education course revealed little relationship to their ratings of the expectancies.

Conclusions. The present health instructional program is in many respects far below the health behavioral level already attained by the first grade child. This is evidenced by the high percentage of first grade children demonstrating desirable health behavior prior to their coming in contact with the formal health instructional program. In addition, there is substantial support of the possibility that many of the expectancies commonly taught could be excluded from the first grade instructional program. These factors would appear to emphasize an immediate need for a gross revision of those health expectancies which are commonly taught in health instruction programs for the first grade.

Recommendations. (1) Greater emphasis should be placed upon determining the health behavior levels of children before establishing health instruction programs. (2) Additional studies should be made at various grade levels to determine the health behavior level within each of these grades. (3) There should be close cooperation among curriculum-planning personnel, parents, and teachers in determining the health expectancies for first grade children. (4) Health textbooks and courses of study should be examined carefully by curriculum planners to determine the appropriateness of the expectancies therein. (5) A study should be conducted to determine why the factor relative to the teachers having had a professional health education course seemed to have little influence on their rating of the expectancies. (6) Continual evaluation of health instruction programs should

be made for the purpose of eliminating the irrelevant material.

Microfilm $3.35; Xerox $11.40. 260 pages.

EFFECTS OF VARIED TEACHING EMPHASES DURING EARLY LEARNING ON ACQUISITION OF SELECTED MOTOR SKILLS

(L. C. Card No. Mic 59-5095)

Pearl Berlin, Ph.D.
The Pennsylvania State University, 1959

This study attempted to determine the effects of beginning learners of different teaching emphases during their acquisition of selected motor skills. The teaching emphases consisted of control (balanced combination of techniques), demonstration, trial-and-error, verbal-detail, and visual-aid experiences. Skills which comprised the experimental design were the golf swing with a #5 iron, the soccer punt for distance, the fencing lunge, the tennis serve, and the catching, while standing still, of a lacrosse ball.

One-hundred and eleven women college students served as subjects of the investigation. Experimental groups were formulated on a random basis. Groups met for sixteen weeks, twice weekly, for instruction and testing.

Instructional procedures included teaching constants which were the same for the five groups. Among these were the introductory lessons, which attempted to give subjects a meaningful idea of the learning tasks and physical practice. Also included in the instruction were the respective experimental variables, namely, the teaching emphases. The total learning time for trail-and-error groups was shortened because of the practice effects involved in their experimental variable.

The Metheny Test of general-motor educability was used as a measure of learning aptness. In each of the five skills, three performance tests were administered. The composite score of the three tests served to represent beginning performance. Covariance analysis, using the Metheny Test score as the control variable and the skill test score as the criterion variable, was calculated for each of the five skills in order to determine whether there were differences in skill acquisition which might be attributed to the experimental variables. Introspective reports were obtained from the subjects by means of questionnaires.

Conclusions of the investigation based on all of the considerations indicated in the structure and implementation of the study were:

1. Analysis of covariance revealed that test scores in performance measures of all five skills seemed to be statistically controlled, to some degree, by the scores of the Metheny Test. Assuming that all other pertinent factors related to such performance did not introduce a serious bias in the study, one may say that the subjects differed significantly in acquired ability. Presumably, these differences can be attributed to the various teaching techniques introduced in the class procedures.
2. Following an opportunity to gain a general idea of the learning task, the acquisition of skill by the beginner seems to be fostered greatly by actual uninterrupted practice. This conclusion was based on the high ranking in performance of the groups exposed to trial-and-error emphases despite their shortened learning period.
3. Following an opportunity to gain a general idea of the learning problem, the beginner seems to be aided considerably in skill acquisition by being subjected to a combination of selected teaching methods such as uninterrupted practice, demonstrations by skilled performers, visual aids, and verbal directions.
4. Demonstrations as an emphasis in the guided instruction of beginners seems to provide some aid to many learners. It cannot be ascertained, though, whether this aid is due to better insight into the skill, or to the motivating effect of demonstrations.
5. Visual aids and verbal analysis seem to rank low in value as an aid to the learning of the beginner in motor skills.

Findings of the study also offer evidence that individual specific aptness, specific abilities already present, and variations in the effectiveness of the learning method from individual to individual all seem to influence the acquisition of motor skills. Collectively, or by themselves, these factors cannot be ignored nor equalized by groups according to some general measure of motor educability.

Microfilm $3.35; Xerox $11.40. 259 pages.

ANXIETY FACTORS RELATED TO SOME PHYSICAL FITNESS VARIABLES

(L. C. Card No. Mic 59-4495)

James Lowell Breen, Ph.D.
University of Illinois, 1959

This thesis proposes to investigate the relationship of anxiety with some heart variables and to determine their predictive values, as well as to interpret the percent contribution of the psychological variables to the brachial pulse wave variables.

The psychological variables include: 1) Taylor Scale: High Anxiety, 2) Factor O: Anxious Insecurity, 3) Factor Q_4: Nervous Tension, 4) High Annoyability, 5) Factor C: Neuroticism, 6) Few Objects Seen in Modern Drawings, 7) Willingness to Adult Fault, and High Cynicism.

The brachial pulse wave variables include: 1) Systolic pressure, 2) Pulse Rate, 3) Angle of Obliquity, 4) Systolic Amplitude, 5) Diastolic Amplitude, 6) Fatigue Ration, 7) Dicrotic Notch Amplitude, and Diastolic Surge.

The subjects used in the experiment came from three groups of male college students. One group consisted of freshmen and sophomore students enrolled in P.E.M. 106. The second and third groups were freshmen and graduate students majoring in Physical Education. A total of 48 subjects, including four from the graduate group, ten from the freshmen majoring in Physical Education, and the remainder being taken from the P.E.M. 106 group.

The Doolittle method was applied in this experiment. The general design of the study is the multiple regression analysis, which uses statistical analysis and predictive

equations to show the weighted value and net contribution of the variables to an established criterion.

The evidence from the first part of the experiment is not sufficient to justify the conclusion, that the eighty psychological variables used to represent anxiety can be used for predictive purposes.

However, using three psychological variables as a unit the following significant relationships are presented.

1) Factor Q_4: nervous tension, Factor C: neuroticism, and high cynicism compared with angle of obliquity gives a multiple "R" of .51, which is significant at the one per cent level of confidence.

2) Factor O: anxious insecurity, willingness to admit fault, and high cynicism compared with systolic amplitude gives a multiple "R" of .48, which is significant at the one per cent level of confidence.

3) Taylor scale: high anxiety, high cynicism, and many objects seen in modern drawings compared with diastolic amplitude gives a multiple "R" of .50 which is significant at the one per cent level of confidence.

4) Factor C: neuroticism, willingness to admit fault, and many objects seen in modern drawings compared with diastolic surge gives a multiple "R" of .48, which is significant at the one per cent level of confidence.

Microfilm $2.00; Xerox $5.00. 97 pages.

A SURVEY OF THE ADMINISTRATION OF INTRAMURAL SPORTS PROGRAMS FOR MEN IN SELECTED COLLEGES AND UNIVERSITIES IN NORTH AND SOUTH AMERICA

(L. C. Card No. Mic 59-4917)

Rodney James Grambeau, Ed.D.
University of Michigan, 1959

The purpose of this study is to ascertain the present status of Intramural Sports Programs in selected colleges and universities in the United States, Canada, and Latin America. An analysis is made of the programs of these educational institutions in the major areas of philosophy and objectives; program evaluation; organization and administration; and program and facilities including: activities offered, eligibility, instruction, facilities, co-recreation, extramural participation, awards, health and safety, protests, officiating, and publicity.

Questionnaires were sent to seventy-two colleges and universities in the United States, ten in Canada, and nineteen in Latin America. Sixty-seven colleges returned completed questionnaires from the United States, nine from Canada, and two from South America. Forty of the forty-nine states in the United States were represented in the study as were nine of the ten provinces of Canada and two of the South American Republics.

The results indicate that the overall developmental picture of intramural sports programs in the schools studied has shown very little progress in the past decade. Highly competitive team and individual games still remain as the core of the intramural program, with a newer recreational concept including outing type activities, social activities, and creative activities being included in the program of a few institutions.

Major reasons reported for many departments not extending their programs are the apparent failure of intramural departments to obtain financial support commensurate with increasing enrollments and the rising cost of materials and services. Adding to this it would appear that many intramural directors are "bogged down" with administrative and program details resulting in a neglect of the development of these areas as well as the areas of public relations, program evaluation, and research.

General conclusions drawn from the study indicate that except in a limited number of institutions few significant advances have been made in the area of intramural athletics. Many new facilities are planned which should be an asset to program expansion. There is a need for greater emphasis on faculty recreation, extramurals, and co-recreation, with greater attention also needed in the area of public relations, program evaluation, accident care and prevention, and methods of financing intramural programs.

Microfilm $2.95; Xerox $10.20. 226 pages.

SELECTION PROCEDURES FOR PHYSICAL EDUCATION PERSONNEL IN STATE TEACHER COLLEGES

(L. C. Card No. Mic 59-4393)

Henry G. Miller, Ed.D.
University of Southern California, 1959
Chairman: Professor Davis

The problem of this study was to ascertain the methods which might be employed by persons charged with the selection of teacher personnel for certain state teacher colleges. The purposes were (1) to gather information for possible use as a guide in the selection of teacher personnel in general and, more particularly, the physical education instructor, (2) to identify selection practices and procedures that were used and those that should be used in procuring qualified teacher personnel, and (3) to compare judgments of selected educator-administrators and qualified graduate college staff members about methods which may influence state teacher college selection practices.

Data were gathered by means of three questionnaires. (1) An instrument was completed by 122 state teacher college presidents or their delegated respondents, who furnished statements of practices and procedures used in the selection of teacher personnel. (2) A questionnaire consisting of these statements was rated by chairmen of departments of physical education and by deans of schools of education. (3) A questionnaire, consisting of the existing selection practices of state teacher colleges, the preferred practices and procedures as indicated by graduate colleges, was sent to selected educator-administrators.

Findings. (1) About 98 (80.3%) of the state teacher colleges discussed the following seven selection steps:

factors related to employment, the qualifications of the candidates, the locating of candidates, the screening of candidates, the interview, and the final selection and announcement of appointment. Seventeen (85%) of the graduate college respondents indicated that these steps should be discussed by state teacher colleges; 12 (80%) of the educator-administrators judged that these procedures should be discussed. (2) Eighty-seven (71.3%) of the state colleges came to a specific oral understanding about the procedures of selection. Sixteen (80%) of the graduate college respondents and 10 (66.7%) of the educator-administrators indicated that these colleges should arrive at a specific oral understanding about these procedures. (3) Sixty-two (50.8%) of the state teacher colleges prepared written statements of the qualifications of candidates; it was found that 61 (less than 50%) of the colleges prepared written statements concerning the factors related to employment of screening of candidates, the interview, and the final selection and announcement of appointment, Twelve (60%) of the graduate college respondents and no less than 9 (60%) of the educator-administrators indicated that state colleges should prepare written statements of these procedures. (4) The state teacher colleges indicated that occasionally the committee—the president, dean of instruction, and department head—held discussions of and arrived at specific oral understandings about the practices and procedures of each step used in selection of teacher personnel. Written statements of the selection steps were seldom prepared by a single committee. The graduate college group indicated that the committees, the dean of instruction and department head, or the department head and staff, should develop the written statements related to practices and procedures; the educator-administrators judged that these colleges should employ the committee—the president, dean of instruction, and department head—to develop the written statements concerning practices and procedures to be followed.

Conclusions. The methods of selection of teacher personnel might be improved if those responsible for state teacher college selection made sure that more varied, more exact, and more verifiable practices and procedures were used in the effort to select the candidates best qualified for positions.

Microfilm $3.50; Xerox $11.80. 269 pages.

AN ELECTROMYOGRAPHIC AND MECHANICAL ANALYSIS OF SELECTED ABDOMINAL EXERCISES

(L. C. Card No. Mic 59-4967)

Jesse Lee Parks, Jr., Ph.D.
University of Michigan, 1959

An electromyographic study of the involvement of the rectus abdominis and lateral abdominal muscles during the performance of selected trunk-flexing and leg-raising exercises, and a mechanical analysis of the muscle force required to maintain static postures of trunk flexion and leg elevation are presented.

Electromyographic records were obtained from twenty-four male subjects with an eight-channel Grass Electroencephalograph, modified for electromyography. Surface electrodes were used, and the subjects performed the exercises from the supine position. The involvement of the muscles and fractionated parts of the muscles were studied, and the exercises were ranked according to the amplitude of the action potentials for the duration of the exercise and at specific angles of flexion.

Data for the mechanical analysis consisted of (1) the relative distances of centers of gravity from reference landmarks, and estimates of the mass of the thoracic, abdominal, and pelvic segments of one cadaver; (2) roentgenograms of the spinal column of one subject; (3) motion pictures of one subject; and (4) limb segment volumes and instantaneous side-view photographs of one subject. In addition, data concerning the location of the center of gravity for the head and neck, and for the limb segments are presented. These data were applied, where pertinent, to the sideview photographs of one subject to determine the abdominal muscle force required to maintain specific angles of flexion.

The findings of this study indicate (1) that there is a very close relationship between the involvement of the rectus abdominis muscle and the muscle force required to maintain specific postures of trunk flexion and leg elevation, and (2) that certain parts of the muscles tested are involved to a greater extent than other parts during the performances of the selected exercises.

Microfilm $2.00; Xerox $6.60. 140 pages.

THE DEVELOPMENT OF AN EVALUATIVE INSTRUMENT DESIGNED TO DESCRIBE THE PERFORMANCE OF THE COOPERATING TEACHER IN THE STUDENT TEACHING SITUATION IN BOYS' PHYSICAL EDUCATION

(L. C. Card No. Mic 59-4554)

John Leon Quaday, Ed.D.
University of Illinois, 1959

The purpose of this study was to develop a workable instrument designed to enable the student teacher in boys' physical education to describe the performance of his cooperating teacher in the student teaching situation.

A review of the literature in physical education and in related fields seemed to reveal need for better analysis of the student teacher-cooperating teacher relationship into its principal dimensions for purposes of study and instrument design.

With the assistance of a jury of experts in student teaching in physical education, the student teacher-cooperating teacher relationship was divided into five dimensional aspects, considered of equal importance as concerned the responsibilities of the cooperating teacher, and defined as follows:

1. Orientation which involves the introducing of the student teacher to his role in the school program by the cooperating teacher.

2. Observation by the student teacher of teaching and related activities as performed by the cooperating teacher.

3. Teaching and Related Activities performed by the student teacher under the observation and supervision of the cooperating teacher.

4. Conferences between student teacher and cooperating teacher.

5. Evaluation of the work of the student teacher by the cooperating teacher.

Two preliminary studies involving the gathering of descriptive information concerning cooperating teacher performance from primary sources were made to help develop a cooperating teacher performance profile in broad perspective.

In the first preliminary study, thirty-two University of Illinois student teachers described ideal cooperating teacher performance in each of the five dimensions just prior to leaving campus for their student teaching assignments.

In the second preliminary study, twenty University of Illinois men who had successfully completed student teaching described actual cooperating teacher performance which had been, respectively, most helpful, undesired and desired but undone.

With ideas collected from the literature and from the preliminary studies, 269 descriptive statements of cooperating teacher performance were structured and worded as though made by student teachers.

Classification of these statements into the five dimensions by university supervisors of student teaching in physical education reduced the number to 250.

A preliminary instrument containing the 250 statements was submitted to a jury of twenty-eight cooperating teachers and eight university supervisors of student teaching in physical education. The purpose of this procedure was to test the consistency of statement interpretation regarding favorability. Jury members evaluated each of the 250 statements using a five-step, Likert-type scale with a "highly favorable-highly unfavorable" continuum. From these results, the 125 most consistently interpreted statements (twenty-five in each of the five dimensions) were selected.

A pilot study to demonstrate the instrument in practical use was designed in which each of twenty student teachers at the University of Illinois evaluated the performance of one of his cooperating teachers using an intermediate form of the instrument consisting of the 125 statements retained from the results of jury evaluation. Each student teacher checked a seven-step, Likert-type scale with a "definitely true-definitely untrue" continuum to describe the performance of his cooperating teacher with respect to each of the 125 statements.

Based upon the results of the pilot study, the five poorest statements in each dimension were eliminated.

The final form of the instrument contains 100 statements (twenty in each of the five dimensions) which survived the complete process of instrument refinement.

Kinds of information obtainable through the demonstrated use of the instrument are reported, and numerous possibilities for the use of the instrument in supervision of student teaching in physical education and in educational research are suggested.

Microfilm $3.05; Xerox $10.40. 233 pages.

EDUCATION, PSYCHOLOGY

FRANZ BRENTANO AND SIGMUND FREUD: A COMPARATIVE STUDY IN THE EVOLUTION OF PSYCHOLOGICAL THOUGHT.

(L. C. Card No. Mic 59-4881)

James Ralph Barclay, Ph.D.
University of Michigan, 1959

The purpose of this study is to compare the essential features of Brentano's psychology of act with psychoanalytic thought. Accent is placed on the central feature of intentionality. Franz Brentano, philosopher-psychologist of nineteenth century Vienna, wrote his Psychology from the Empirical Viewpoint at the time Sigmund Freud was a young university student. In the years 1873-1876 Freud took no less than five consecutive courses from Brentano. Among these were "The Philosophy of Aristotle," a course in "Philosophical Readings," and "Logic." In this study the author develops the hypothesis that contact with Franz Brentano and his ideas constituted a personal influence in the intellectual development of Sigmund Freud.

The methodology of the study is that of historical and literary comparison together with logical analysis. Though no evidence survives the burning of Freud's memoirs from this period of his life, the author was fortunate in making the acquaintance of Dr. John C. M. Brentano, only son of Franz Brentano. Dr. Brentano supplied the author with unpublished manuscripts of his father. Among these were some teaching outlines of Franz Brentano dating back to 1872-1873. The brief notes of these outlines indicate that Brentano was concerned with psychic phenomena, that he believed in instinctual presentation as a determining force in psychic development, and that he suggested a detailed investigation of bizarre psychic phenomena including somnambulism and dreams.

Though the teaching outline dating from this period is of interest, the emphasis in this study is on Brentano's early psychological views as presented in his Psychologie. In this work, Brentano studied the nature of psychic phenomena, characterizing all psychic activity by an intentional existence which was primarily related to object presentation (Vorstellung) and secondarily to the ego or self. The author was aware of the knowledge among nineteenth century psychologists concerning the concept of the unconscious, neurological models of human behavior, the threshold of consciousness, and the conflict between psychology as a branch of speculative philosophy and the opposing view which regarded it as based on physiology. It is for this reason that chief accent in this study was centered on the concept of intentionality, which is distinctly unique to Brantano as the reviver of a scholastic tradition. The author believes from his study that there is a similarity between Brentano's intentional existence and Freud's doctrine of object-cathexis. Comparison is also made between the methodological theory of Brentano and the clinical method of Freud.

The similarities between Brentano's act psychology and the theoretical framework of psychoanalysis are ascribed in part to the great teaching ability of Franz Brentano. Brentano also taught Edmund Husserl, Carl Stumpf and Alexius Meinong. It is the author's contention that Brentano's teaching on the nature of the intentional existence is an essential feature of both psychoanalytic thought and Gestalt psychology.

The conclusions of the study are limited to the hypothesis presented. It is difficult to establish the face of personal influence between Brentano and Freud without more documentary evidence than is now known to exist. Nevertheless, from the number of courses taken, the overwhelming testimony to Brentano's teaching personality from his other famous students, and the intrinsic similarities in the matter of intentionality and methodology, the author holds that the probability of such and influence is substantiated. Microfilm $3.45; Xerox $11.80. 266 pages.

STIMULUS PROPERTIES OF WORDS: VARIABLES RELATED TO SPELLING DIFFICULTY.

(L. C. Card No. Mic 59-3509)

Richard Hutcheson Bloomer, Ed.D.
University of Southern California, 1959

Chairman: Professor Thorpe

This study tested the influence of each of ten stimulus variables on the spelling difficulty of words. The variables were word length, frequency of occurrence, frequency of the letters in the word, irregularity of external configuration, phonetic complexity, emotional tone of the sounds of letters in the word, number of meanings of the word, concreteness of the meaning, emotional positiveness or negativeness of the meaning, and emotional intensity of the meaning of the word.

The above variables were correlated with each other and with criteria of spelling difficulty. The criterion which best predicted spelling difficulty was the grade level at which 50 per cent of the children spelled the word correctly as taken from Greene's The New Iowa Spelling Scale (State University of Iowa, 1953).

Findings. The following variables related significantly to spelling difficulty: word length, $r = .617$; frequency of occurrence, $r = -.443$; $\log_2$ of frequency of occurrence, $r = -.592$; number of meanings, $r = -.315$; concreteness of the meaning, $r = .264$. The other stimulus variables were not significantly related to the spelling difficulty of words.

The above relationships produced the following multiple regression equation:

$$SD = 3.02 + .452(WL) - .398(L_2F) + .079(EI) - .061(M) - .045(C)$$

where:

SD was the grade level at which 50 per cent of the children spelled the word correctly,

WL was the length of the word in letters,

L_2F was the $\log_2$ of the frequency of occurrence as found in Rinsland's A Basic Vocabulary of Elementary School Children (Macmillan, 1945),

EI was the judged emotional intensity of the meaning of the word,

M was the number of dictionary meanings of the word,

C was the judged concreteness of the meaning of the word.

The formula afforded the following prediction of spelling difficulty:

$$R_{1.23456} = .75$$

When the regression equation was reduced to two variables as follows, a multiple correlation of .74 resulted:

$$SD = 5.56 + .471(WL) - .432(L_2F)$$

Conclusions. (1) An important result of the study was the lack of significant contribution to spelling difficulty of many stimulus variables. The finding that spelling difficulty could be effectively predicted by word length and $\log_2$ of frequency indicated that the spelling word was for the child a heterogeneous response chain with terminal reinforcement. Spelling teaching is thus primarily a problem in the organization of material for effective serial learning. (2) Since the major errors in serial learning occur in the middle of the chain, a spelling method which emphasizes the center of the word would be most effective. Letter-by-letter phonics method of teaching reading would be most beneficial to spelling learning. However, more evidence is needed before this technique may be recommended as best for reading teaching. (3) Syllabification as a spelling teaching method would serve to shorten the length of the response chains and thus offer a technique to simplify the spelling word for more effective learning. (4) The superiority of $\log_2$ of frequency of occurrence over simple frequency of occurrence attested to the increased importance of initial repetitions, indicating that efforts must be made to have children respond correctly to initial spelling contacts. This argued for strong guidance in initial teaching, for the study-test method of presentation, particularly in the early grades, and for techniques of grading spelling words in terms of probable error to insure maximum initial correct responses. (5) The superiority of $\log_2$ of frequency of occurrence served also as an argument against drill by writing words a large number of times, for the increment of learning per repetition diminishes rapidly.

Microfilm $5.30; Xerox $18.80. 416 pages.

PERSONAL AND SOCIAL ADJUSTMENT IN COEDUCATIONAL AND SEPARATE CATHOLIC SECONDARY SCHOOLS.

(L. C. Card No. Mic 59-4700)

Sister Marie Siena Chmara, O.P., Ed.D.
Wayne State University, 1959

Adviser: William Reitz

This study involved an investigation for the purpose of determining whether the formal organization of either a coeducational high school or a single-sex high school significantly affected the personal-social adjustment of adolescents. The influence of these two types of schools on the scholastic achievement of the students was likewise studied.

The first part of this study was resolved into three hypotheses which were tested by an analysis of variance. They are the following:

I. The factors of school type, sex, grade, intelligence, and all their interactions have no significant effect on the personal adjustment of the subjects.

II. The factors of school type, sex, grade, intelligence, and all their interactions have no significant effect on the social adjustment of the subjects.

III. The factors of school type, sex, grade, intelligence, and all their interactions have no significant effect on the scholastic achievement of the subjects.

The subjects of this investigation were 200 students selected from among the ninth and twelfth grade boys and girls attending one of three schools represented in the study. The first of these schools was a coeducational parochial high school; the second, an all-boy school; and the third, a school for girls. These students were classified into three intelligence levels by using their scores on the California Test of Mental Maturity. The experiment represented a 2 x 2 x 2 x 3 factorial design, the main sources of variation being the two sexes, the two grades, the two types of schools, and the three levels of intelligence.

The data analyzed by variance analysis were obtained from the results of the students' responses to the California Test of Personality and from their scholastic marks for the year during which this study was conducted. The results of this analysis showed that none of the factors had any effect on the personal adjustment of the subjects. When the second hypothesis was studied, the sex of the student was identified as a factor affecting social adjustment. Here the girls earned significantly higher scores than the boys. As a result of testing the third hypothesis, sex and intelligence were identified as factors affecting scholastic achievement. The analysis disclosed that girls achieved more scholastically than boys, and that the more intelligent were those who received the best grades in school. None of the interactions were identified as significant ones in influencing either the personal-social adjustment or the achievement of the students.

The second part of the investigation attempted to study the students' appraisals of their school's morale. A Student Index, consisting of seventy-three items descriptive of the school and relationships within it, was used for evaluation purposes. The students' affirmative or negative responses were translated by teacher judges into responses showing favor or disfavor toward the school, and these in turn were studied statistically by the method of critical ratios. This procedure led to the following general conclusions:

1. Twelfth grade girls, regardless of the type of school, responded more favorably toward their school than twelfth grade boys.
2. When the responses for students from the separate schools were compared with those from the coeducational school, all comparisons, with the exception of that between ninth grade boys, showed significantly greater satisfaction within the separate school.
3. In general, the girls were identified as the group most satisfied with the conditions existing in their schools.

Microfilm $2.15; Xerox $7.60. 161 pages.

THE EFFECTS OF MULTI-VARIATE SELECTION AND MILD STRESS UPON COMPLEX PROBLEM-SOLVING AND CREATIVE THINKING.

(L. C. Card No. Mic 59-4714)

Maury Harry Chorness, Ph.D.
The Uniyersity of Texas, 1959

Supervisor: Dr. Carson McGuire

Three experimental groups were equated on Anxiety and Achievement Motivation. Each group contained forty-five subjects. The sample was drawn from Air Force basic trainees. The three groups corresponded to experimental conditions of Mild Stress, Feeling-Feedback (Relaxed), and control. Experimental variables were represented by complex problem-solving and creative thinking. Creative thinking was represented by responses rated as High-Quality and a residual of responses identified as Low-Quality ideation. Intelligence was held constant so that effects of personality and experimental conditions could be observed.

The following main findings emerged from an intercorrelation of all variables. Intelligence revealed a low, significant relationship with High-Quality ideation. Achievement Motivation had low, significant correlations with problem-solving and High-Quality ideation. Problem-solving and High-Quality ideation were correlated significantly with a small relationship. Low-Quality and High-Quality ideation were uncorrelated when scores for each measure were combined, respectively, into a single distribution regardless of experimental conditions. Within Feeling-Feedback (Relaxed) and Control conditions, a small, significant relationship was found between the same measures. The correlational results indicated that Achievement Motivation was a significant trait in problem-solving and creative thinking. Results also indicated that the ratio of High-Quality ideational fluency might be due partially to conditions under which such test responses were obtained.

A separate analysis of covariance was conducted with each experimental variable. In each analysis, statistically significant results were in favor of a triple interaction. In problem-solving, superior performance was found with individuals selected on Middle Anxiety, Middle Achievement Motivation, under Mild Stress. Individuals selected on Low Anxiety, High Achievement Motivation, subjected to Control conditions, also produced superior scores.

In Low-Quality ideation, groups identified as Middle Anxiety and Low Achievement Motivation, under Mild Stress, were found to be more productive. The Low Anxiety, High Achievement Motivation group, under Control conditions, again was found to produce relatively higher scores.

In High-Quality ideation, individuals selected on Middle Anxiety and High Achievement Motivation, under Mild Stress, were superior performers. Subjects identified according to Low Anxiety, High Achievement Motivation, under Control conditions, again comprised a high group. Subjects belonging to the Low Anxiety, High Achievement Motivation group, under Feeling-Feedback (Relaxed) conditions, also produced high scores. Their superiority was not as pronounced when compared to the two preceding trait-condition combinations.

General findings support the conclusion that achievement-motivated individuals require only the provocations of normal test situations to produce superior performance provided they possess little anxiety. With a decrement in achievement motivation, increased tension might be necessary for comparable performance. This tension could arise simultaneously from two sources, namely, moderate internal anxiety and mild situational stress. High anxiety would work against superior performance. Low achievement motivation, with moderate anxiety and mild stress, would appear to be sufficient for productivity on Low-Quality ideation. High achievement motivation would appear to be the necessary additive for High-Quality output.

Final discussion is devoted to assumptions underlying contemporary measures of anxiety. Limitations to existing measures of drive are examined and suggestions are offered for a more scientific measurement of drives leading to improved prediction of situational behavior. Implications also are presented for the field of education. Findings are discussed in the light of classroom atmospheres and personality differences as they may affect student achievement. Inferences also are directed at increasing educational emphasis being placed upon social competence and emotional maturity.

Microfilm $2.00; Xerox $6.80. 141 pages.

AN EMPIRICAL STUDY COMPARING VARIOUS METHODS OF ACHIEVEMENT EXPECTANCY BY MEANS OF MENTAL ABILITY.

(L. C. Card No. Mic 59-4389)

Jerry Craig Garlock, Ph.D.
University of Southern California, 1959

Chairman: Professor Meyers

A child's achievement test score is most appropriately interpreted in light of his mental ability. This problem of expectancy which relates ability measurement to achievement measurement involves a more tedious approach as attempts are made to refine the degree of ability and its relation to finer degrees of achievement. There are various methods of refining the predictive level of attainment that an individual might be expected to obtain on an achievement test in relation to his ability. The methods investigated in this study are twofold: (1) the difference between mental test scores and achievement test scores which involved difference equations and (2) the actual level of attainment which an individual is expected to achieve on an achievement test with reference to a mental ability test. These are called expectancy equations. The difference equations investigated in the study are as follows: (1) arithmetic difference equations, (2) two-variable estimated true difference equations, (3) three-variable estimated true difference equations, and (4) approximate estimated true difference equations. The expectancy methods investigated in the study are as follows: (1) the Horn Formula, (2) the single-variable regression equations, (3) the two-variable regression equations, and (4) the Anticipated Achievement. These various methods were compared with regard to

characteristics of the equations and the results which they yielded.

Findings. (1) Difference equations do not give the same results and cannot be interpreted in the same way as expectancy equations. (2) The estimated true difference equation involves a more sophisticated approach due to the inclusion of the effects of regression and reliability of the tests. (3) A single estimated true difference equation whose coefficients are based upon the data from the total of the thirteen districts does not give equivalent expectancy differences to those of the estimated true difference equations whose coefficients are based upon data from individual districts. (4) The estimated true difference equations yield essentially the same results, whether or not the effects of chronological age are added as variable. (5) The approximate estimated true difference equation is not a good substitute for the estimated true difference equation. (6) The arithmetic difference does not give the same results as the estimated true difference equation. (7) Although the reliabilities of the scores of any difference equation vary over a relatively large interval, there is little variation of reliability between the various difference methods for any district. (8) A single regression equation cannot adequately represent various grades and various achievement areas. (9) The inclusion of chronological age in the regression equations did not appreciably influence the results obtained when chronological age is not used. (10) The Horn Formula yields different results from the regression equations whose coefficients are obtained from district data or a total of all the districts' data. (11) Regression equations based on different mental ability groups present a more representative set of equations for a district than does a single equation. (12) The Anticipated Achievement duplicated the contours of the regression equations based on different ability groups rather well.

Conclusions and Recommendations. It is concluded with regard to difference equations that the estimated true difference equations yield more accurate and representative results than the arithmetic difference or the approximate estimated true difference equations. The same expectancy equations cannot be used for reading and arithmetic or for various grade levels, whether they be the Horn Formula or regression equations. The Anticipated Achievement adequately represents regression expectancies throughout most of the range of mental age. If a district is concerned with local comparisons, the single variable regression equation is recommended in preference to the Horn Formula or the more complicated two-variable regression equation. If a national or broad-base comparison is desired, it is recommended that a type of expectancy similar to the procedure employed by the Anticipated Achievement be used.

Microfilm $3.30; Xerox $11.20. 253 pages.

THE DETERMINATION AND STUDY OF ACADEMIC UNDERACHIEVEMENT IN THE NEW YORK STATE COLLEGE OF HOME ECONOMICS AT CORNELL UNIVERSITY WITH IMPLICATIONS FOR COUNSELING AND ADMISSIONS.

(L. C. Card No. Mic 59-5289)

Barbara Jane Arthur Gordon, Ed.D.
Cornell University, 1959

Statement of Problem

The purpose of this study was to determine students who were achieving below potential, to study the causal factors involved in this underachievement, to compare the causes of underachievement in this group to findings of other studies and to recommend future action in the selection and counseling of students.

Procedure

Multiple regression equations were employed to ascertain the predicted college averages of 407 students in the Classes of 1956, 1957 and 1958 in the New York State College of Home Economics at Cornell University. The independent variables utilized were high school average and the Verbal Score on the Scholastic Aptitude Test. Fifty-four students had averages that fell one standard deviation or more below their predicted averages and were labeled underachievers. Students whose averages fell one standard deviation or more above their predicted averages were denoted overachievers. The records of 56 overachievers were used in this study for comparison purposes only.

The material collected from structured interview situations and college records included: background information; test scores; college academic performance; college social activities; vocational interests; part-time and summer employment while in college attendance; physical health and admissions and counseling information.

Results

The results of this study were noted in two distinct categories. First, the variances and similarities between the underachievers and overachievers were indicated. Briefly, the family backgrounds of the underachievers and overachievers differed in that the overachievers' parents tended to have more formal education and to be employed mainly in the professional and managerial occupations. The overachievers tended to rank higher in their high school classes. The median size of home community for underachievers and overachievers was similar. The Kuder Preference Record, the Strong Vocational Interest Blank and the Allport-Vernon-Lindzey Study of Values failed to noticeably differentiate between underachievers and overachievers. The underachievers were found to have failed subjects and to have been placed on academic probation, whereas the overachievers had not. The extra-curricular activity participation for both underachievers and overachievers was similar; however, the overachievers tended to hold more positions of responsibility. In the area of vocational interest it was noted that the underachievers changed their interests more than the overachievers. It was found that most of

the underachievers and overachievers had worked during summer vacations and a similar number worked during college. However, the underachievers worked more when first in college and they also tended to work more hours per week.

Several characteristics of the underachiever population were noted from the structured interview situations. It was found that the underachievers tended to date two to three times per week more than the average home economics student. They seemed to value college social life highly. In the academic area they felt that their study habits were poor, their reading average and their class absenteeism average. Most of the underachievers felt insecure in the college academic situation.

Conclusions

The New York State College of Home Economics has a Counseling Service which performs admissions, counseling and orientation functions. Its policies and procedures represent nearly all the positive findings in current literature in the counseling and admissions areas. The main suggestion was the possibility of inclusion of a "diversified" study skills unit in the orientation course. The investigator urged more cooperation between secondary schools and colleges in the admissions and counseling areas; a more positive attitude, in general, toward Home Economics and more literature giving the College Home Economics picture in order to attract top high school students.

Research in the field of underachievement should be continued as should the study of test development in the areas of motivation and aptitude, especially for Home Economics. Microfilm $4.50; Xerox $15.00. 350 pages.

THE CONGRUENCE OF BEHAVIORISTIC AND PSYCHOANALYTIC SCHOOLS OF PSYCHOLOGY WITH THE THOMISTIC CONCEPT OF HUMAN NATURE, AND THE IMPLICATIONS FOR GUIDANCE AND COUNSELING PRACTICES IN THE CATHOLIC SCHOOL.

(L. C. Card No. Mic 59-4703)

Sister Mary Ann Thomas Griffin, O.P., Ed.D.
Wayne State University, 1959

Adviser: Mildred Peters

The student of psychology with a strong background of religious conviction is often disturbed by the seeming disharmony between scientific psychology and philosophical principles. He finds it difficult at times to reconcile the amoral point of view frequently adopted by scientific psychology with the moral position indicated by his ethical beliefs. He becomes confused by the different points of psychological subject-matter that seem to bear resemblance to, and yet differ from, his philosophical principles.

The present study, Thomistic in approach, is an attempt to indicate to such students and to teachers naturally interested in the educational implications of psychology, some areas of confusion resulting from this difficulty. It attempts also to point out certain elements from the psychological concepts of the behavioristic and psychoanalytic schools of thought that are acceptable to the Thomistically-orientated person and which can be integrated into his psychological system.

In the beginning of the study, there is traced the historical development of the work of Saint Thomas Aquinas, the decline of its influence outside the church schools after the death of the saint and the resurgence of Thomistic thought in response to the encyclical letter of Pope Leo XIII in the late nineteenth century. Following the plan of the Summa Theologica the study delineates the Thomistic concept of human nature. It emphasizes the importance placed by Saint Thomas upon the unity of body and mind in human operations, the influence of the emotions, and the over-all mastery by the intellect and will of man's behavior.

The third chapter summarizes the important aspects of behavioristic psychology as found in the works of the late Clark Hull. There is noted the philosophical orientation, the peripheral attitudes and the formal synthesis of Hullian theories. A digest of both analogous and disparate elements of the Hullian and Thomistic schools is given.

In similar fashion, the major concepts of psychoanalytic psychology following the work of Otto Fenichel as representative of the system are presented. Particular attention is paid to the structure of the psyche, principles of development and factors that relate themselves to the learning situation. Here also, the areas of agreement and of disagreement between this system and that of Saint Thomas are indicated.

The final chapter, in presenting the Thomistic psychology of education, incorporates into the discussion which is philosophical as well, those points from Hullian and psychoanalytic psychology that are compatible with Thomism. Implications are indicated for guidance and counseling practices.

While rejecting the philosophical tenets of behaviorism concerning the nature of man and the application of laboratory findings concerning animal behavior to human beings, the author concludes that certain conclusions involving habit formation and motivation are acceptable to a limited degree and are important. Likewise, the deterministic philosophy of psychoanalysis is denied by the Thomistically-orientated individual, but he admits that the psychoanalytic school has much to offer, due to its insistence upon consideration of the "whole man" with his emotions, his experiences, and his early family relationships. These are in accord with the Thomistic concept of human nature and in total agreement with the Catholic view of the importance of proper family life and parental influence upon the formation of satisfactory character development and structure of personality.

Microfilm $2.35; Xerox $8.20. 177 pages.

A COMPARISON OF VERBAL CONCEPTUALIZATION IN DEAF AND HEARING CHILDREN.

(L. C. Card No. Mic 59-4521)

Robert Bruce Hughes, Ph.D.
University of Illinois, 1959

Previous research had shown that while the deaf are impaired in abstract reasoning and abstract concept development, they perform nearly as well as the hearing on low-order concepts, particularly those which can be concretely represented. However, very little evidence was available on the verbal concept knowledge of deaf children. Hence, the present comparison between the verbal conceptualization in deaf and hearing children was undertaken, verbal conceptualization being defined as the ability to sort known percept words under known concept words.

Thirty-three hearing and fifty-six deaf residential school children between ten and fourteen years of age with mental ages from nine and a half to fifteen and a half reacted to a newly devised verbal task requiring the sorting of known percept words under known concept words. This percept testing-concept sorting task yielded seven measures of verbal concept performance, which along with the control variables of mental age, chronological age, sex, and length of residence in the school, were utilized in the comparisons of the performances of the hearing and the deaf groups as well as between different deaf samples.

The major hypothesis investigated was: There are no statistically significant differences between the performances of hearing and hearing-impaired children of the same mental ability in percept and concept behavior as reflected in the accuracy with which they relate known percepts to known concepts. Various minor hypotheses concerning the different deaf samples were also tested. The results from testing the major and minor hypotheses as well as other considerations resulted in the following general conclusions. (1) The hearing children performed significantly better than did the deaf children with respect to percept and concept behavior. (2) The performances of the orally and acoustically trained deaf did not differ significantly although they were superior to those of the manually trained children. The results in general suggested a continuum of conceptual behavior such that the hearing did better than the acoustically handicapped and, within this latter group, those who had been taught by speech reading and by sound amplification did better than those taught by a manual method. (3) Sex differences in the performances of the orally trained and acoustically trained children were slight and statistically insignificant; none was found within the hearing group. (4) The hearing children made more wrong sorts as compared to the deaf, but generally there was a plausible basis for this placement. The deaf did less well with easy concepts than did the hearing. (5) Length of residence for neither deaf nor hearing was significantly related to performance on the task. (6) The percept testing, concept sorting task appeared to be a feasible method for measuring percept and concept word knowledge in deaf and hearing children. It was recommended that, with slight modifications in the words selected for the method, it should be useful in assessing verbal concepts in other children where something more than vocabulary competency is to be studied.

Microfilm $2.15; Xerox $7.60. 162 pages.

OBJECTIVES, METHODS, MATERIALS, AND EVALUATIONS IN THE FIRST COURSE IN PSYCHOLOGY.

(L. C. Card No. Mic 59-3523)

Virgil Lee-Roy McPherson, Ed.D.
University of Southern California, 1959

Chairman: Professor Lefever

The purpose of this study was to make a national survey, for the immediate postwar period, of the objectives, methods, materials, and evaluations in the first course in psychology in the state universities and the small independent colleges of the United States and of specific materials of instruction in the state teachers colleges. An attempt was made (1) to compile a list of the objectives, methods, materials, and factors affecting evaluations which were used in the first course in psychology; (2) to ascertain which of these were emphasized and which, in the judgment of faculty and students, should have been emphasized; and (3) to discover in this emphasis and these judgments differences between state universities and small independent colleges, between faculty and students, and between actual practice and the "ideal."

The instruments developed to obtain the data were three forms of a 240-item questionnaire which included 75 objectives, 86 methods, 43 materials, and 36 factors influencing evaluations. Data were contributed by 405 respondents from 127 institutions in 46 states.

Findings and Conclusions. (1) Objectives for the first course in psychology tend to extend in multifarious directions. (2) Traditional methods predominate in the teaching of the first course in psychology. (3) Emphasis in the first course in psychology varies according to the type of institution. (4) The status of emphasis on objectives, methods, materials, and evaluations in the first course in psychology is far behind the "ideal" as judged by faculty and students. (5) In general, the majority of students agree with their instructor's opinion of the "ideal" emphasis on the objectives, methods, materials, and evaluations in the first course in psychology. (6) Teachers in the first course in psychology believe that the basic scientific approach to the study of human behavior should receive the primary emphasis but also that useful applications should be encouraged. (7) The small independent colleges (a) place more emphasis on the social and personal adjustment of the student, (b) are more concerned with his guidance, and (c) pay more attention to the development of his interests, attitudes, habits, and ideals than the state universities in the first course in psychology. (8) The state universities in the first course in psychology give more attention to understanding man as a biological organism in a social environment. (9) Similar opinions on the "ideal" emphasis on objectives, methods, materials, and evaluations in the first course in psychology are held by students in the state universities and small independent colleges. (10) Psychology instructors in the first course in psychology in the state university wish to place greater emphasis than the instructors in the small independent colleges on (a) man as a biological organism, (b) technical vocabulary and concepts, and (c) psychology as a pure science without regard to applications. (11) Psychology instructors in the first course in psychology in

the small independent colleges, more than those in state universities, believe in emphasizing the development within the student of (a) ethical character, (b) emotional control, (c) leadership to improve social conditions, and (d) interest in building a better world. (12) Instructors and students wish to supplement and enrich the traditional methods of teaching the first course in psychology.

Microfilm $7.70; Xerox $26.40. 608 pages.

STUDENT ATTITUDES TOWARD GROUP SCHOLASTIC APTITUDE TESTS.

(L. C. Card No. Mic 59-4368)

Richard Alvin Merriman, Ed.D.
The University of Nebraska Teachers College, 1959

Advisers: Charles O. Neidt, Ph.D. and
Gordon H. Henley, Ph.D.

Purpose of the Study

The purpose of the study was: a) to develop an instrument for measuring the attitudes of students toward group scholastic aptitude tests; and b) to employ the instrument to ascertain relationships between the attitudes toward group scholastic aptitude tests, and 1) test scores, 2) students' ratings of the testing and counseling services provided by their high school, and 3) a school administrator's listing of the testing and counseling services provided by the school.

Method of Procedure

Attitude was defined and statements constructed accordingly. From the original 70 statements, 28 were retained through judges' opinions and item analysis.

A scale for student rating of the high school testing and counseling services, a scale for school administrators' ratings of the high school testing and counseling services, high school Intelligence Quotients, and college American Council on Education Psychological Examination Quantitative and Linguistic scores were also employed.

The sample consisted of 1001 college-planning high school seniors from 24 selected high schools, 319 non-college-planning seniors from three high schools and 893 University of Nebraska freshmen, including 219 who were also in the college-planning high school seniors group.

In developing the attitude scale, the following evaluative techniques were used: judges' opinions, item analysis, the Spearman-Brown formula for reliability, and tests of significance between the scores obtained by test-retest procedure.

The differences between mean scores of groups were determined by t-tests. Coefficients of correlation were obtained to establish relationships between scores. An analysis of regression was computed for the college-planning high school subjects to ascertain inter-relationships between attitude scale scores, Intelligence Quotients, and students' ratings of the high school testing and counseling services.

Conclusions

The general conclusions formulated on the findings in this investigation are as follows:

High school seniors from high schools with a more comprehensive testing program, counseling program or combined testing and counseling program attained significantly high attitude scale scores; higher than those of students from high schools with less comprehensive programs.

The attitude scale scores of the college-planning high school seniors were significantly higher than the attitude scale scores of entering college freshmen. The threat situation at the time of completing the scales may account for the difference.

College-planning high school seniors were significantly higher in their attitudes toward group scholastic aptitude tests than non-college-planning seniors from the same schools.

College girls scores significantly higher than college boys on the American Council on Education Psychological Examination Linguistic test and significantly lower on the Quantitative test.

High school seniors were significantly higher than college freshmen in the student rating of the high school testing and counseling service.

At both levels, girls were significantly higher than boys in the rating of the high school testing and counseling services.

Attitudes toward group scholastic aptitude tests correlate positively and significantly with the group mental test results and with the students' ratings of the testing and counseling service. The relationship of attitudes to the group scholastic aptitude test scores is greater than the relationship between attitudes and the students' ratings of the high school testing and counseling service.

The coefficient of correlation between high school Intelligence Quotients and American Council on Education Quantitative scores was significant, but that between the Intelligence Quotients and the Linguistic scores was not significant.

High school size was not related to attitudes toward group scholastic aptitude tests.

All scholastic aptitude test scores correlated positively and significantly with attitude toward group mental test scale scores.

High school girls are significantly higher than high school boys in their attitudes toward group scholastic aptitude tests. Microfilm $2.00; Xerox $6.60. 139 pages.

AN EXPERIMENTAL STUDY TESTING THE VALUE OF USING MULTISENSORY EXPERIENCES IN THE TEACHING OF MEASUREMENT UNITS ON THE FIFTH AND SIXTH GRADE LEVEL.

(L. C. Card No. Mic 59-5120)

Edward Raymond Mott, Ed.D.
The Pennsylvania State University, 1959

This study was designed for the purpose of measuring certain experimental methods of teaching, namely, a prearranged system of multisensory materials. The particular areas of attitude, quantitative understanding, and computation ability were studied. Pre and post tests were administered to both experimental and control pupils. The tests were:.

1. Attitude Toward Any School Subject
2. Quantitative Understanding
3. Basic Computations

The control section composed of 157 pupils in six classes proceeded as usual throughout the school year. No attempt was made to influence this group as to time, method, or aids used.

Multisensory aids were used at every opportunity during arithmetic measurement classes in the experimental section which was made up of 70 children in two classes.

Mean changes were calculated for experimental and control sections for each factor: attitude, quantitative understanding, and basic computation. Mean changes were also calculated between these two major sections. Subdivisional analysis such as: sex, mental age, and combination of these two factors was made on each group to determine whether the changes of one of these factors were significantly more favorable than the changes of others.

Attitude:

Attitude scores of both the control and the experimental group showed no significant increase when the factors of sex, mental, or combined sex and mental age were considered.

Quantitative Understanding:

1. Both the experimental and the control groups gained during the experiment.
2. The experimental group did not gain significantly over the control group.
3. Significant gains were observed by each group when sex, mental age, and combined sex and mental age were considered.
4. No significant gains were shown when the experimental and control sections were compared on the basis of sex, mental age, and combined sex and mental age.

Basic Computation:

1. Both the experimental and the control group gained on the basic computation test.
2. The experimental group did not gain significantly over the control group.
3. Significant gains were observed when sex, mental age, and combined sex and mental age were considered.
4. No significant gains were shown when the experimental and the control sections were compared on the basis of sex, mental age, and combined sex and mental age.

Implications for Teachers:

This study shows that significant gains resulted under both experimental and control conditions. In spite of the fact that the experimental group did not gain significantly over the control group on the three areas tested, this should not be construed to mean that the experimental methods should not be used. Teachers should make more use of the experimental techniques outlined in this study and various evaluation processes should be applied to measure gains.

Microfilm $2.20; Xerox $7.80. 167 pages.

PERCEPTION OF MENTALLY SUPERIOR CHILDREN BY THEIR CLASSMATES IN FOURTH, FIFTH AND SIXTH GRADES.

(L. C. Card No. Mic 59-4551)

Norval Lee Pielstick, Ph.D.
University of Illinois, 1959

Since previous research, particularly that of Terman, et al., had consistently shown that mentally superior children are characterized by certain traits, this study sought to determine whether these children are perceived by their peers as possessing such traits and to analyze some of the concomitants of this type of social perception.

Fourteen traits were selected from Terman's "Composite Portrait of the Gifted Child" and were formulated into items for a Guess Who test. Four other items were added to obtain evidence regarding global reactions toward the superior subjects. These items required the children to nominate those most different from themselves, most like themselves, those they most wanted to be like and those they most wanted to be different from.

Three types of subjects were involved in the study, viz., children with Stanford-Binet IQ scores of 140 or higher (high-superior), those whose scores on the California Test of Mental Maturity (CTMM) were approximately equivalent to Binet IQ's of 130 to 140 (low-superior), and those whose scores on the CTMM were below the minimum for low-superior subjects (non-superior). The subjects were selected from fourth, fifth and sixth grade classes in the public schools of Wichita, Kansas. Sixth high-superior subjects were identified and included in the study, 20 at each grade level. Only those classes containing one or more high-superior subjects were included. There were 158 children in these classes who qualified as low-superior subjects; the remaining 1034 children were classified as low-superior subjects.

Guess Who tests were administered to 1203 children (60 high-superior, 152 low-superior, and 991 non-superior subjects) who were located in 42 classrooms of 21 elementary schools. The subjects were instructed to write in the names of the three classmates regarded as most possessing each trait. For each superior subject, data were collected also on age, sex, achievement scores, IQ scores, date of entry into the classroom, and the socio-economic status of the school.

The nominations received by the superior subjects were compared with chance expectancy and were further analyzed with reference to grade levels, socio-economic levels of schools, and total achievement scores.

On each of the 14 selected traits, the high-superior subjects were found to have been nominated beyond chance expectancy, significant at the .01 level of confidence. Low-superior subjects were nominated significantly more frequently than chance on 11 of the 14 traits. It was noted that both high- and low-superior subjects tended to be nominated more frequently on traits pertaining to scholastic or intellectual characteristics than on those pertaining to social, emotional, or physical characteristics. As grade level increased, the low-superior subjects were nominated more frequently on a constellation of traits which seemed to center around increasingly successful or satisfying school experience while the reverse trend seemed to characterize the high-superior subjects. Those

high-superior subjects who were in schools of low socio-economic status tended to be nominated more frequently than those in schools of high socio-economic status. Partial rank correlation coefficients between nomination and achievement scores for high-superior subjects, with IQ held constant, were positive on all of the traits, but highest on traits of an intellectual or scholastic nature. Globally, the high-superior subjects were regarded with statistically significant frequency as the ones their classmates wanted to be like. The low-superior subjects were significantly regarded by their classmates as being different from themselves and, at the same time, as the ones they wanted to be like.

In general, these findings were interpreted as indicating that these mentally superior children, especially the high-superior ones, were perceived by their classmates as possessing the traits which have previously been reported to characterize gifted children and did not "suffer" socially in being so regarded.

Microfilm $2.20; Xerox $7.80. 166 pages.

A Q-TECHNIQUE STUDY OF CERTAIN HYPOTHESIZED DIMENSIONS OF GROUP BEHAVIOR.

(L. C. Card No. Mic 59-4397)

John LeHane Rinn, Ed.D.
University of Southern California, 1959

Chairman: Professor Carnes

This investigation in the field of group psychology was concerned with the problem of identifying the basic concepts, variables, and "facts" with which theories of group dynamics should deal. The study attempted to describe suitable techniques for identifying the essential dimensions of a social interactional field. The major hypothesis of the study was that certain theoretically defined dimensions of group behavior could be verified by means of Q-technique operations.

In selecting the theoretical dimensions of group behavior for investigation, certain assumptions regarding human nature and human interaction were made as follows: (1) A theory of group behavior must start with a theory of individual behavior, since groups gather in order that individuals may satisfy their needs. (2) Individual behavior takes place within a "social field," the perception of which influences the individual's choice of behaviors. (3) The process of interaction among individuals in a group situation is guided by some more or less clearly defined goals and purposes, and the attainment of these common goals and values is the primary job of the group and the reason for its existence. (4) The unit of description of a group process should include all three elements just described—the individual, the situation, and the directional tendency guiding the interaction between these two elements.

The concepts selected to describe the level of individual behaviors were denoted by the labels friendly, aggressive, and avoiding. The concepts describing the group climate or situational field were labeled supportive and nonsupportive. The concepts involving attainment of goals were called group-oriented, self-oriented, and nonoriented.

The research methodology selected was that advocated by William Stephenson and called by him Q-metholology. A research instrument of the Q-sort type was constructed in the form of a factorial design and administered to two training groups from the Western Training Laboratory in Group Development. Members were requested to describe the behavior, feelings, or attitudes of their group by sorting the statements into nine piles in a forced-choice, approximately normal distribution. Factor analytic and analysis of variance procedures were applied to the Q-sort data to determine which hypothesized dimensions, if any, had been experimentally verified.

Findings. The hypothesized dimensions were found to contribute significant sources of variation to each of four rotated factors. Significant cell statements were examined and synthesized into a factor name and descriptive summary for each factor as follows: (1) Tension Control as a Means of Member Involvement and Group Goal Facilitation: Group goals were advanced and some personal needs were met when the passive member was prodded, the aggressive member opposed, and the friendly member supported. (2) Sociability: Friendly behavior was encouraged, while aggression and passivity were opposed. (3) Forced Participation as a Means of Group Growth: Forced participation of members led to group growth, but did not result in the meeting of personal needs or in group disruption. (4) Self-oriented Goal Attainment.

Conclusions. The major hypothesis of the study was found to hold. Thus, when group members who had no prior knowledge of the theoretical framework of the Q-instrument gave Q-sort descriptions of their own group processes, statistical analyses of these descriptions showed that the members were sensitive to some of the predicated effects. Factor interpretations were descriptive at the level of the whole situation, emphasizing the concept of group goal attainment through a dynamic balance of member involvements. Methodologically, it was concluded that Q-methodology makes possible the wedding of theory-building and data-gathering, and that Q-technique procedures make it feasible for the individual experimenter to perform basic research in the field of group psychology.

Microfilm $3.00; Xerox $10.20. 230 pages.

VALUE-ORIENTATIONS OF ADMINISTRATORS OF PUBLIC SECONDARY SCHOOLS OF TEXAS.

(L. C. Card No. Mic 59-4744)

Hattie Jean Jones Shelton, Ph.D.
The University of Texas, 1959

Supervisor: Professor Carson McGuire

The present study was instigated to answer questions concerning the school administrator's attitude toward various areas of operation. The assumptions made are that a wide range of individual differences is legitimate, and that behavior in choice situations indicates values. Two general propositions are tested: Administrators tend to maintain the same value-orientation throughout the several areas of action, and the areas of action and attitudes are related to the size of the school system.

Attitudes representing underlying value-orientations

were inferred from behavior described by schoolmen in interviews and on an especially constructed sentence completion instrument. "Operational" was the label assigned to action showing a preference for well established policies. An "immanent" attitude was regarded as the protecting of a natural development from external influence. When external forces mold behavior, the value was designated "external." A fourth group of behaviors showing indecision between policies or between policy and action was titled "ambivalent."

Areas of administrative action were reduced to five by limiting the study to fields most directly affecting the learning-teaching process. Included areas were: discipline of students, faculty management, direction of student activities, supervision of teaching, and the professional climate of tenure and advancement.

The instrument for choice behavior to reveal values was a Q-sort consisting of a structured sample of 100 items. Items in the Q-sample were selected from a theoretical universe of statements about administrative behavior and were so arranged that there were five replications of behavior patterns representing each of the four attitudes, i.e. 20 items for each of the 5 areas.

The instrument was administered to 32 subjects widely spread geographically but confined to Texas. The sample population was chosen to include four equal subsamples, divided on the basis of size of school district and population.

Each subject was asked to undertake two sorts. The first, called "present," consisted of evaluating items according to present practice in his school. In the second sort, "desired," items were tallied according to how he would like them to be distributed. There were nine degrees of reaction available for each situation from "most like" to "least like." The advantage of comparability among discriminations was enforced by limiting the number of items placed in each category.

Of the 23 measures yielded by analyses of variance on the variables of attitude, area choice, sorting, subsamples, subjects, and items, most yielded positive results and are detailed in the study. A partial summary follows:

1. The Q-items are relevant. Every item was selected for inclusion on the basis of principal response in pilot studies and each was considered present in at least one school reported in the study.
2. There is a very strong pattern of area choice with all subjects favoring faculty management and student activities. Supervision was uniformly low-rated.
3. Although the overall pattern of administrators was for operational attitudes, differences according to subsample were significant.
4. Principals in the large city schools were the most operational.
5. In towns of only one high school with an enrollment of more than 500 students, principals reported more freedom in establishment of policy.
6. In the smallest schools of less than 100 students, conditions of great disparity between practice and ideal were reported by two principals.
7. Principals from all schools are guided by the same aim: to meet the need of students. The further analyses of responses showed the "need" aim to have very different interpretations and to be invalid for inclusion in a study of value-orientations.
8. All principals considered external influences on policy making to be most undesirable, and not present except in rare instances.
9. The Q-sort is useful in finding patterns for a single respondent or for a group. It can, therefore, be recommended for use by a responsible agency, researcher, or superintendent.

Hypotheses suggested for further study are:

1. School systems of similar tenure patterns have principals with similar degrees of correspondence between "present" and "desired" sorts.
2. In schools where principals have clearly defined attitude- and area-preferences, successful teachers have similar patterns of behavior-preferences, and unsuccessful teachers have confused or conflicting value-orientations.
3. In situations where the principal reports considerable disparity between "present" and "ideal" situations, similar split will be reflected in teacher respondents.

Microfilm $2.00; Xerox $6.40. 133 pages.

PERSONALITY AND ATTITUDE CHARACTERISTICS ASSOCIATED WITH "THERAPY READINESS".

(L. C. Card No. Mic 59-4745)

Kathryn Irma King Skinner, Ph.D.
The University of Texas, 1959

Supervisor: Gordon V. Anderson, Ph.D.

In order to investigate the diagnostic and prognostic validity of the counselor's judgment of a client's "readiness for therapy," a theoretical formulation of the psychological construct "therapy ready" was developed within the framework of Roger's Self-Theory. As a consequence of this formulation, it was predicted that clients judged "therapy ready" would score on objective personality tests more anxious, less defensive, less comfortable and less satisfied with their concepts of self than clients judged not "therapy ready," but would not differ on certain other personality variables. The "therapy ready" client would more frequently report, during a standardized interview, attitudes which reflect realistic perceptions of counseling; he would return for more counseling interviews and be judged by his counselor as having a more successful outcome to his counseling than the client who was not "therapy ready." The research data supported all of these predictions.

Microfilm $2.00; Xerox $5.40. 106 pages.

A STUDY OF THE IDENTIFYING CHARACTERISTICS OF SELECTED JUVENILE DELINQUENTS.

(L. C. Card No. Mic 59-4179)

Martin Luther Stamm, Ph.D.
Purdue University, 1959

Major Professor: Elizabeth K. Wilson

At the suggestion of the Superintendent of Schools and the Mayor of a city of over 100,000 in population, a study concerned with juvenile delinquency was begun on January 1, 1956. The sixteen and seventeen year old pupils were chosen for study because, according to police records, they had had consistently the highest frequency of delinquent acts. Delinquency as defined in this study represented "action by 16 - 17 year olds which involved these pupils with the police."

The purpose of the study was to explore the use of the pupil cumulative records in an effort to determine whether or not information gathered by the schools on all pupils was related to delinquency to an extent that indicated possible predictive value of such data.

If it could be shown that the school records of delinquents as compared to the records of the non-delinquents were significantly different by an amount greater than chance, then a device would be developed to test the predictive validity of the variables of the records.

From January 1, 1956, to January 1, 1957, a study of all 16 - 17 year old delinquents was made in Mid-Western City, the anonymous name given to the city involved in this research. This part of the population became the experimental group. The delinquents were compared with all other 16 - 17 year old pupils in Mid-Western City. This part of the population served as the control group. One hundred and thirty-three delinquents were compared with a control group numbering 1,259 pupils.

The cumulative records of this research population were examined according to the following three areas of the school records: Family Data, Tests, and Academic Record.

Sixteen variables of cumulative record information were organized into tables and an appropriate chi square test was administered.

Fifteen variables were found to be significant at the one percent level of confidence and one variable, Race, was significant at the five percent level of confidence.

Evidence gathered from testing seventeen variables of the pupil cumulative records supported the hypothesis that delinquents might be distinguished from non-delinquents by the data available on the cumulative record cards. This seemed to justify the development of a plan to test predictions made on the basis of cumulative card data.

A teacher observation chart was then constructed to be used experimentally as a device for determining whether valid prediction of potential delinquency could be made.

From the cumulative records beginning with the first grade, predictions would be made experimentally and the variables on which they were based would be charted for each first grade pupil in Mid-Western City. If increases in the number of variables significantly related to delinquency appeared at any point of the individual's progress through school, the resources available to the school would be used and the outcomes recorded.

In addition to the experimental uses of the chart, the following recommendations were made:

1. A comparative study of the ten classifications of offenses to determine the possible patterns of records common to the various offenses. Were those pupils, for example, involved in auto thefts different from the sex offenders and if so in what manner?
2. A study of the repeater delinquents in terms of their school records.
3. A study of neighborhood environment and recreational facilities in relation to the incidence of delinquency. Are there significant differences in the environment of the delinquents whose fathers are engaged in blue collar jobs and in the environment of those whose fathers were in the white collar jobs?
4. A study of referrals to the Pupil Personnel Department by the various schools to determine the relationship of the use of referral resources to the percent of delinquents in the respective school districts.

Microfilm $2.00; Xerox $5.60. 111 pages.

EVALUATION OF A SOCIAL LIVING COURSE WITH ADDED LABORATORY NURSERY SCHOOL EXPERIENCE.

(L. C. Card No. Mic 59-5011)

Harriet Eleanor Skidmore Whitney, Ph.D.
University of Michigan, 1959

The study is an evaluation of a social living course in conjunction with laboratory nursery school experience. The first experimental group of 191 ninth-grade students in Highland Park High School was enrolled in the social living course and participated in the secondary laboratory nursery school as student teachers. The second experimental group of 40 ninth-grade students in an East Detroit junior high school was enrolled in a social living course with no concurrent laboratory experience. The control group of 160 ninth-grade students in the same school in East Detroit had no course in social living and no laboratory experience.

The study tested the following hypotheses: (1) Ninth-grade students who have had systematic instruction in social living with experience in a laboratory nursery school will change in a specified direction in attitudes toward developmental tasks, family life, child behavior and child care, when compared with those students who have not had such a laboratory course; and these changes will vary with sex, intelligence, and socioeconomic status. (2) Ninth-grade students who have had systematic instruction in social living without the laboratory experience will not change in the above attitudes in comparison with those students who have not had such a course.

The measures of the dependent variables were the McCleery Scale of Adolescent Development to measure attitudes toward developmental tasks, the Elias Family Opinion Survey to measure attitudes toward family life, a Student Opinion Survey to measure attitudes toward child

behavior, and a test to measure attitudes toward child care.

Differences between the means of the experimental and control groups at the beginning of the experiment were found not to be significant on socioeconomic status, attitudes toward developmental tasks, family life, and child care. Differences in intelligence quotients and in attitudes toward child behavior were found to be significant. Analysis of the data at the end of the study yielded the following significant differences between the mean changes of the first experimental group and the control group in the desired direction: (1) In attitudes toward child care, which was not affected by division of the groups by sex, intelligence, or socioeconomic status. (2) In attitudes toward the developmental tasks of peer relations, physique acceptance, and preparation for family life. (3) In attitudes toward family life which was also found in the mean change of the lower-quartile I.Q.'s and higher quartiles for socioeconomic status of the first experimental group when compared with those quartile mean changes of the control group. (4) In attitudes toward child behavior. Further analysis of the first experimental group revealed no significant differences in mean change on the dependent variables when the group was divided by race and by siblings under six years of age. Analysis of the data on the mean change between the second experimental group and the control group produced only one significant change in the specified direction. It was between the mean change of upper-quartile I.Q.'s in attitudes toward developmental tasks.

The following conclusion is drawn from the study: For the groups studied, it was found that the means of changes in the direction of desirable attitudes toward developmental tasks, family life, child behavior, and child care on the part of those who have had a social living course in personal and social development with classroom instruction and guided laboratory experience were significantly greater than were the corresponding means for those who did not have such a laboratory course.

Microfilm $2.00; Xerox $6.40. 134 pages.

EDUCATION, TEACHER TRAINING

A STUDY OF PRACTICES IN HOME ECONOMICS TEACHER EDUCATION IN SELECTED COLLEGES AND UNIVERSITIES IN THE UNITED STATES WITH IMPLICATIONS FOR THE HOME ECONOMICS TEACHER EDUCATION PROGRAM IN THE PHILIPPINE WOMEN'S UNIVERSITY, MANILA.

(L. C. Card No. Mic 59-2630)

Marie Fe Gonzales Atienza, Ph.D.
Michigan State University, 1959

Major Professor: Mary Lee Hurt

The purpose of the study was to examine practices in home economics teacher education in six selected colleges and universities of the United States and to formulate their implications for the home economics teacher education program of the Philippine Women's University, Manila. Three phases were considered: (1) the organization and administration of the home economics program, (2) the practices followed in assisting families in meeting their needs, and (3) approaches related to developing understanding of current educational practices.

The study was in two women's colleges in the South, and in three state colleges, and one land-grant university in Michigan. Sixty-one persons were interviewed. They included a dean, a chairman, and three heads of college, school, division, or department of home economics; heads or persons-in-charge of home economics education; supervising teachers, college supervisors, itinerant teacher trainers, counselors, advisers; an assistant dean of a college of home economics; an assistant dean of a college of education; registrar; teachers of subject matter areas for foods and nutrition; home management, child development, family relations, color and design, housing, home furnishing and equipment, home economics education, health, school and society, early childhood education; a nursery school director; home management house residence director; and heads of departments of education and teacher education.

Information about needs of the Filipino families were obtained through a questionnaire sent to three hundred and twenty mothers in the Philippines, and about current educational practices through a questionnaire sent to one hundred and sixty-nine Filipino educators. From the results of the questionnaire, three interview schedules were evolved. The first interview schedule pertaining to practices in the organization and administration of home economics was used with administrators of home economics. The second interview schedule pertaining to practices in preparing prospective teachers of home economics in assisting families in meeting their needs was used with teachers of subject matter areas in home economics and related fields; while the third, pertaining to helping prospective teachers of home economics to understand current educational practices was used with persons concerned with home economics education and general professional education courses. The data obtained described practices in the organization and administration of home economics, in assisting families in meeting their needs, and in understanding current educational practices.

There were different administrative organizations for home economics and home economics education in the six colleges and universities studied. The home economics program was administered by a dean, chairman, or head of a college, school, division, or department of home economics. The home economics education program was administered by a head or a person in charge of a department or an area in the department of home economics, School of Applied Arts and Sciences, or a section of the department of teacher education.

Thirteen needs of Filipino families which had been identified by Filipino mothers were used in interviewing teachers of subject matter areas in home economics and related fields. The practices they mentioned as most used in assisting families in meeting these needs were: using films; analyzing case studies; performing demonstrations; having self-analysis; inviting resource persons to talk to the class; observing and participating in the activities of the nursery school; discussing readings and findings; discussing problems of the students and their

families; having field trips; planning; preparing, and serving meals for different income levels and age levels; and recognizing the values of the contributions of the homemaker.

Ten current educational practices followed in the Philippines were used in interviewing American educators. The approaches which most of them followed in preparing prospective teachers of home economics to understand current educational practices were: visiting schools and communities; discussing as a class; observing and participating in activities of the nursery school and the adult homemaking classes; discussing problems of the student and her family; planning by both teacher and pupil together; committee work; providing a variety of reading materials and teaching techniques; using the teacher as an example of progressive teaching; inviting resource persons to talk to the class; and having much pupil activity.

All the practices and approaches obtained in preparing prospective teachers of home economics were evaluated in terms of their applicability to the situation of the Philippine Women's University. Implications were made for the home economics teacher education program of the University.

This study was intended to be illustrative of the type of research which teacher education institutions might do for the different teaching fields. It would seem that in making curricular plans for preparing prospective teachers of home economics, a great deal of consideration should be given to how they can assist families in meeting their needs. They should also be thoroughly conversant with and understand current educational practices.

Microfilm $4.10; Xerox $13.80. 320 pages.

CURRENT PROFESSIONAL, SOCIAL, AND ECONOMIC STATUS OF BACHELOR DEGREE GRADUATES OF SAM HOUSTON STATE TEACHERS COLLEGE ENTERING TEACHING, 1953-1957.

(L. C. Card No. Mic 59-4411)

Elliott Toulmin Bowers, Ed.D.
University of Houston, 1959

This study has been conducted and reported as fact-finding research to determine the status of a specified group of graduates entering teaching from a particular institution during a limited period of time.

Data on professional, social and economic status were collected in the following areas and sub-areas: 1) community and school--size of community in which born, size of community in which lived during pre-college years, size of community in which now living, size of community in which now teaching, number of teachers in school in which teaching; 2) family background--occupation of father, age, sex and marital status, number of children; 3) teaching preparation and experience--semester hours credit earned beyond bachelor's degree, total years of full-time teaching experience, total years of full-time service in school system in which teaching, number of different school systems in which taught full-time, number of years absent from teaching since beginning to teach, primary reason for most recent break in teaching service; 4) income and family finances--salary for teaching, percentage of total income made by teaching, spouse gainfully employed, total money income of "spending unit" of which a member, total short-term consumer debt owed, living arrangements; 5) teaching assignment--grade level teaching assignment, extent to which teaching single grades or fields vs. combinations, field of teaching and degree of concentration in one field, per cent of teaching time in grades or fields different from field of major preparation, size of classes taught, total number of pupils taught, instructional qualifications (three areas of greatest instructional competency and three areas of least instructional competency), evaluation of teaching materials and equipment available, evaluation of classrooms, activities other than class instruction, number of hours per week devoted to school duties and activities outside school hours; 6) teacher and the community--membership in a church, active membership in types of community organizations, voting practice in most recent election; 7) teacher and the profession--membership in professional educational organizations, membership in local, state or national organization devoted to some subject or teaching field, reappraisal of career choice, plans to continue teaching; 8) professional advice--more time and emphasis, less time and emphasis, reasons if were to leave teaching profession permanently.

The survey was conducted by mail using a pre-coded questionnaire that included, other than for identification purposes, thirty-seven check-list items and three open-end questions. Data were machine processed and the findings were arranged in three-dimensional tables (by teaching experience, teaching level, and sex) for each of the sub-areas indicated above. The data in each table were interpreted according to the following common format: 1) beginning elementary teachers (1956-1957 teaching graduates); 2) beginning secondary teachers; 3) experienced elementary teachers (1953-1955 teaching graduates); 4) experienced secondary teachers; and 5) respondents as a total group.

Typical teacher profiles were developed for each group. Profiles, reported incompletely here, revealed the teachers to be 23 to 26 years old, married, church members, voters and members of at least one community organization. They have training above the bachelor's degree, were satisfied with teaching situations, and would again become teachers. They felt least adequate in teaching slow-learning pupils and bright but uninterested or uncooperative students. Greatest instructional strengths were felt to be knowledge of subject matter and ability to maintain leadership and control of classes. Low salaries for men, $3,500 to $3,999, and marriage and family for women would be primary reasons for leaving teaching permanently.

The nature of this study has been fact-finding and reporting. Application of the findings by colleagues has been anticipated and some suggestions have been enumerated.

Microfilm $3.05; Xerox $10.40. 235 pages.

AN EVALUATION OF OPPORTUNITIES IN MUSIC EDUCATION IN THE PREPARATION OF ELEMENTARY SCHOOL VOCAL MUSIC TEACHERS AT WAYNE STATE UNIVERSITY.

(L. C. Card No. Mic 59-4699)

Lillian J. Cassie, Ed.D.
Wayne State University, 1959

Adviser: Lynn N. Nicholas

The purpose of this study was to evaluate the vocal music education program at Wayne State University in order to determine its adequacy in light of the positions to be filled by its graduates.

A check list, personal interview, and questionnaire were used to secure data from administrators, graduates, and student teachers.

A survey of elementary school music teaching patterns in eighty-nine school systems in Metropolitan Detroit revealed that in eighty-four, vocal music is taught in whole or in part by specialists.

Information from the survey and other criteria served as sources for designing a questionnaire. Graduates and student teachers evaluated opportunities in basic music, musical performance, music education methods, and observation and student teaching. Conclusions drawn from data resulting from these evaluations are as follows:

1. Preparation in basic music meets the criteria in areas of dictation and sight singing, but not in writing, arranging, and functional piano.

2. Opportunities in musical performance are adequate in areas of voice instruction, performance in choral groups, and the study of standard literature of the major instrument. They are inadequate in conducting, study of orchestral instruments, and in performing repertoire at the level of recital standards.

3. Preparation in music education methods is adequate in rote and reading songs, rhythmic activities, listening habits, remedial work, planning, and understanding of personal qualifications, but is inadequate in the following areas: knowledge of a variety of philosophies and methods, classroom teachers' problems and the specialist's role as a consultant, creative activities, business aspects of music education, and junior high school problems.

4. Of the four areas, student teaching best meets the accepted criteria. Preparation is adequate in all singing and rhythmic activities, length and scope of experience, planning, routine affairs, observation of music classes, evaluation, and application of theory learned in methods courses. Opportunities need to be strengthened in creative activities, use of instruments, working with special groups, and correlating music with other subject areas.

5. The majority of respondents prefer methods prior to student teaching.

Recommendations are as follows:

1. A workshop-type course in class piano for the development of functional piano skills, aimed at accelerated learning, should be organized. It should be taught by regular faculty members.

2. Conducting experiences with live groups should be provided. Choral and instrumental ensembles should be formed in conducting classes, directors of university performing groups should provide more conducting opportunities for students, and supervising teachers should provide more opportunities for students to work with special groups.

3. Music education students should be required to perform in public recitals. Final applied music examinations could become recitals with audiences composed of a faculty examining jury and students taking applied music. Open evaluation sessions could be included.

4. Further study should be made of students' understanding of orchestral instruments.

5. Students should be provided with a broader background in teaching methods. They should undertake individual research, investigate programs of suburban school systems and report findings to methods classes. Workshops for classroom teachers could be arranged in which students assume some responsibility in planning and participation.

6. Observation should begin in the sophomore year with a gradual induction into participation. The methods class should meet weekly in a neighboring school with the college instructor teaching the children.

7. Centers should be established in suburban school systems for the third student teaching experience. Students would assume full responsibility in one school or in several, and work with the classroom teacher on a specialist-consultant or coordinator basis depending on the organization of the system. College supervisors would provide supervision and work closely with administrators.

Microfilm $3.80; Xerox $12.80. 294 pages.

VALUES OF HIGH SCHOOL HOMEMAKING TEACHERS.

(L. C. Card No. Mic 59-4518)

Alberta Dee Hill, Ed.D.
University of Illinois, 1959

The study was designed to apply some of the psychological concepts of values to a study of the values and value patterns of high school homemaking teachers. Knowledge was sought of (1) value patterns which might be characteristic of homemaking teachers, (2) the amount and kind of variation in those value patterns, and (3) the possible correlates of such variations. Justification of the study is dependent upon the acceptance of the theory of the relationship between personal values and behavior; and the acceptance of the importance of teachers having some insight into their own values. The ultimate purpose of the study was to develop an instrument that could be used to help teachers understand their own values.

Value was defined as an idea, condition, person or object which the teacher sees as contributing to her well-being as a homemaking teacher. The eight values tested were prestige and status, intellectual activity, social service, social relationship, aesthetic appreciation, family life, ease and convenience, and standards.

The study was made by obtaining responses on an original instrument, Personal Choices of Homemaking Teachers, which was mailed to homemaking teachers in Connecticut and Illinois. In this instrument one statement related to each of the eight values was paired with statements related to every other value in three different contexts: teaching positions, homemaking departments,

and teaching goals. The forced-choice response required yields a rank order of the eight values.

Responses of 262 high school homemaking teachers from two states indicated that the general tendency was for these teachers to select Social Service, Social Relationship and Family Life items most often. There was a definite tendency for Prestige and Status, Ease and Convenience, and Aesthetic Appreciation items to be ranked low.

An analysis was made of the possible relationships between value scores and (1) the level taught, (2) years of experience, (3) credits earned beyond a bachelor's degree, (4) years elapsed since college credit was earned, and (5) marital status. Significant relationships discovered were:

1. Married teachers placed a higher value on family life than did single and widowed or divorced teachers.
2. The proportion of high scores on Social Service was greater for teachers who check that less than five years had elapsed since college credit had been earned.
3. Teachers with more than five years of service valued intellectual activity more than did teachers with less than five years of experience.
4. Single teachers chose Social Service items proportionately more often than did married teachers.

Some evaluation of the instrument was made through examination of the intercorrelation of the 24 items and the factor leadings of the items on ten factors determined by factor analysis. Eight rather definite factors revealed included Standards, or Quality, Intellectual Activity, and Personal Ease and Convenience. Two Prestige and Status factors were different in that one was more related to Home Economics and the other seemed to be a more general professional prestige factor. There were three social factors, Social Leadership, Personal Relationships, and Sociability.

On the basis of interdependence of value items discovered through use in this study, suggestions for revisions could be made. Further suggestions for revision were secured from a few of the individuals involved in the study and in trial uses of the instrument. Continued evaluation of the instrument through additional testing of revised forms is needed.

Microfilm $2.00; Xerox $5.20. 105 pages.

THE AVAILABILITY FOR TEACHING OF NONCERTIFIED COLLEGE GRADUATES.

(L. C. Card No. Mic 59-4759)

Herbert Ferd LaGrone, Ed.D.
The University of Texas, 1959

Supervisor: Dr. James G. Umstattd

Purpose and Method

The purpose of this study was to determine the availability, recruitment, selection, preparation, characteristics, and success in teaching of noncertified college graduates by an analysis of the unpublished reports of nine selected projects sponsored by The Fund for the Advancement of Education and related data. The study also tested the assumption that liberal arts graduates constitute a reservoir for new teachers for the public schools.

Findings

No exact estimate of the availability of noncertified college graduates could be made because of a variety of factors but it appears safe to assume that the number is not so large as was anticipated by the project planners. The total college graduate population represents no more than 4.5 per cent of the total population of the United States.

It was found that over 90 per cent of the 4,676,840 men college graduates majored in fields of study directly related to future careers and since 96 per cent of them were employed in only four major occupational classifications it is probable that the men college graduates were employed in their fields of preparation.

It was found that over 75 per cent of 3,152,216 women college graduates majored in fields of study directly related to future careers and that over 52 per cent of them had prepared for teaching while completing their undergraduate work. The number of women college graduates had been about one hundred and five thousand each year from 1948 through 1955.

The marital and family status of women restricted their labor force participation. Of the 75 per cent of women college graduates classed as "ever married," three-fourths had one or more children.

Each of the projects assumed that the pool of noncertified college graduates existed since they attempted to recruit persons holding the bachelors degree with no previous work in professional Education and better than average undergraduate academic success as reflected by the grade point average. In addition, certain personal qualities were considered and inducements, such as excellent scholarships, accelerated programs, advanced degrees, or a promise of employment, were used.

The selected projects recruited five hundred participants out of approximately one thousand applicants. The grade point average of the group was about C but some had experienced outstanding success as undergraduates. The age distribution of the participants was bimodal at twenty-three and thirty-three years due to the fact that some projects gave emphasis to recent college graduates and other eliminated this segment of the sub-population. About 80 per cent of the participants were women. The younger age group had a high program completion percentage but dropped out of teaching due to marriage and family status at a rather high rate whereas the older group had a lower completion percentage but tended to stay in teaching at a higher rate. The teaching success of the group was not as high as might have been anticipated from a highly selected group.

The preparation programs for the participants were similar to the modern programs in teacher education, and were designed to give the participants both the necessary knowledge for teaching, and the skills of teaching. The projects appeared to have assumed that the participants had a broad general education and were a homogeneous group.

Conclusions

The pool of noncertified graduates as a source for new teachers is limited in itself, and is further reduced by the

general conditions existing in the labor market, economy, marital and family patterns, and the teaching profession.

The analysis of the projects shows that the possession of a college degree does not assure that the person can, or would want to teach; that the noncertified college graduate who teaches needs, wants, and profits from specific preparation for teaching; and that factors other than the possession of a college degree must be considered in the selection of public school teachers.

The study indicated that the percentage of college graduates preparing to teach while completing their undergraduate work is almost as high as could be anticipated under the existing conditions. To increase the number and percentage to a higher magnitude, the influence of other factors must be modified.

Recommendations

Teacher education institutions and the public school systems should continue experimentation in programs of teacher education. Other projects, with emphasis on the potentially superior teacher, should be developed and supported by a variety of private capital sources.

Since the pool of liberal arts graduates is small, studies of such other potential sources as those persons of ability who have completed less than four years of college and those high school graduates of superior ability who would not go to college should be made.

Since the evidence indicates that the teacher shortage is a resultant of factors other than a simple relationship between supply and demand, further research on the holding power of teaching as a profession should be made.

Microfilm $3.55; Xerox $12.20. 276 pages.

THE RELATIONSHIP BETWEEN ACHIEVEMENT IN ELEMENTARY ARITHMETIC AND VOCABULARY KNOWLEDGE OF ELEMENTARY MATHEMATICS AS POSSESSED BY PROSPECTIVE ELEMENTARY TEACHERS.

(L. C. Card No. Mic 59-4550)

Clarence Alois Phillips, Ed.D.
University of Illinois, 1959

Problem

The problem of this study was to determine the degree of relationship between arithmetic achievement and vocabulary knowledge of elementary mathematics as possessed by prospective elementary teachers. Related problems of this study were as follows:

1. To determine the degree of relationship between arithmetic achievement and mental maturity and also between vocabulary knowledge of elementary mathematics and mental maturity
2. To determine the degree of relationship between arithmetic achievement and vocabulary knowledge of elementary mathematics, holding mental maturity constant

Procedure

A total of 52 students enrolled in Mathematics 202 (Arithmetic for Teachers) at the University of Illinois (Urbana, Illinois) was used in the study. All of the students in the study were enrolled in the College of Education. Three tests were given at the beginning of the second semester, 1958-9. The tests given were as follows:

1. Achievement Test in Elementary Arithmetic
2. Vocabulary Test in Elementary Mathematics
3. The California Short-Form Test of Mental Maturity, S Form 1957

A forty item achievement test in elementary arithmetic was developed for this study. The items comprised operational skill in performing conventional computations in whole numbers, common fractions, decimal fractions, per cents, and verbal problems.

A vocabulary test was also developed for this study. It was a recall type of test consisting of fifteen selected terms from elementary mathematics. As a scoring guide, appropriate knowledge was listed for each of the fifteen terms, with the amount of points to be given. The objectivity of the scoring was validated by four judges.

Summary and Conclusions

Product-moment correlation coefficients were computed between the various scores. The correlation between arithmetic achievement and vocabulary knowledge of elementary mathematics was found to be .53. The correlation between arithmetic achievement and mental maturity was .42. The correlation between vocabulary knowledge of elementary mathematics and mental maturity was .25. Even though the correlation coefficients of .53 and .42 are significant at the 1% level, the relationships are not extremely high. The correlation coefficient of .25 is not significant at the 5% level.

Holding mental maturity constant, the correlation between arithmetic achievement and vocabulary knowledge of elementary mathematics was found to be .49. This partial correlation coefficient is approximately the same as that of the product-moment correlation coefficient of .53.

Correlation ratios were computed between the various scores. Considering vocabulary scores as a function of achievement scores, the correlation ratio was found to be .64. The hypothesis $N_{yx} = \rho$ was accepted (5% level of significance). This indicates that there is a linear relationship between arithmetic achievement and vocabulary knowledge of elementary mathematics.

Using Y (vocabulary scores) as a function of X (achievement scores), it was found that the standard error of estimate was 5.1. If achievement scores would be considered as a function of vocabulary scores, the standard error of estimate was 7.1. There is a greater error of estimate in predicting achievement scores from vocabulary scores than in predicting vocabulary scores from achievement scores.

The correlation between arithmetic achievement and vocabulary knowledge of elementary mathematics was .53. The coefficient of determination, r^2, is .28. Twenty-eight per cent of the variance in Test Y is associated with the variability in Test X.

There was a wide range of scores on all of the tests. The range for each of the three tests was as follows: arithmetic achievement 18% - 100%, vocabulary knowledge of elementary mathematics 25% - 50%, and mental maturity 94 I.Q. - 143 I.Q.

Microfilm $2.00; Xerox $6.00. 121 pages.

ENGLISH-LANGUAGE PREPARATION REQUIRED OF PROSPECTIVE TEACHERS OF HIGH-SCHOOL ENGLISH IN AMERICAN COLLEGES AND UNIVERSITIES.

(L. C. Card No. Mic 59-4571)

William Reynolds Slothower, Ed.D.
University of Illinois, 1959

The amount and kind of special study of English language, exclusive of composition, required of prospective teachers of high-school English was studied by means of a questionnaire survey. Attention was focused on required study of the history, grammar, and usage of English; a subsidiary line of inquiry was concerned with the present status and future prospects of structural grammar in the training colleges.

The investigator designed a questionnaire and distributed it to the chairmen of English departments of 395 colleges and universities. The survey-design was set up so as to include each state university, each of the other state-supported institutions offering secondary teacher education in each state, and a proportion of private colleges and universities in each state. Usable replies were received from 360, or 91% of the colleges. These institutions produced 5441 English teaching-majors during 1957, or 78% of the total 1957 supply of new high-school teachers certified that year with English as the major field.

Principal findings of the study follow, grouped according to the three main lines of inquiry.

Extent of Required Study

(1) Of the 360 participating institutions, 71% (producing 75% of the total of teaching-majors) required one or more courses in special study of the language of teaching-majors.

(2) Among those 256 colleges requiring courses, 77% (involving 75% of the majors) required a single course.

(3) Supplemental instruction in grammar and usage was undertaken in the methods course, required of 78% of the majors in 74% of the participating colleges.

(4) Approximately one-third of the colleges that offered a curriculum for minors required some special preparation in English language beyond composition of teaching-minors.

Nature of Required Study

(5) Study of grammar predominated among required courses.

(6) A general emphasis on current American English as opposed to historical study of the language predominated; considerable emphasis was reported being given study of the facts of English usage.

(7) Systematic study of theory and method of linguistics was not reported as a requirement.

(8) Some attempt was being made in required courses to include broader aspects of language study, such as its psychological and sociological dimensions.

(9) A large assortment of grammar textbooks was reported in use. Two of the most widely used were highly traditional in orientation, terminology, system, and methodology. Four structural grammars were reported as basic textbooks in required grammar courses.

Structural Grammar

(10) Approximately one-half of the colleges requiring grammar study reported giving structural grammar no attention at all or only slight attention.

(11) Among the colleges requiring grammar study, 22% reported giving "considerable" attention to structural grammar; "full" (i.e., exclusive) use of the structural approach was reported by 9% (20 institutions).

(12) Little inclination to change was reported among the large majority of English departments that were not presently doing much with structural grammar.

On the basis of these findings, the following conclusions appeared to be warranted:

(1) Special study of English language is regarded at this time as sufficiently important to be required in most curricula for prospective English teachers.

(2) However, the prevailing pattern of a single required course (beyond composition study) now appears to be insufficient as a basic minimum program.

(3) Large numbers of prospective teachers of high-school English are not presently getting the kind of instruction in English language recommended by leaders in the profession.

(4) Considering its recent introduction, structural grammar has had considerable impact on programs of preparation of English teachers.

(5) There exists a need for studies of the applicability of structural grammar to teaching of the language arts in the high schools.

Microfilm $2.15; Xerox $7.60. 161 pages.

EDUCATION, THEORY AND PRACTICE

THE COMPARATIVE EFFECTIVENESS OF TWO PATTERNS OF TEACHING SAFE TRACTOR OPERATION AND MAINTENANCE TO HIGH SCHOOL STUDENTS OF VOCATIONAL AGRICULTURE.

(L. C. Card No. Mic 59-5097)

Benton Keith Bristol, Ed.D.
The Pennsylvania State University, 1959

The study was designed to compare the effectiveness of two patterns of teaching safe tractor operation and maintenance to high school students of vocational agriculture. Three criteria, developed for the study, were (1) a pencil-and-paper, true-false test, (2) an individual student oral examination, and (3) a check list of approved practices. Effectiveness of teaching patterns was measured in

terms of subject matter knowledge, performance skills and understanding of basic principles, and approved practices adopted. The three classifications of students tested were (1) all students in the sample, (2) the sub-group of students with access to tractors, and (3) a sub-group of students with safe tractor operation and maintenance improvement projects.

Special teaching aids, and individual instruction in their use, were provided the cooperating teachers of vocational agriculture to insure a uniformly high quality of basic instruction. The essential difference between the two patterns of instruction was that in Pattern I most of the work was done in the school farm shop and classroom through teacher-student cooperation, and in Pattern II most of the work was done on the home farm through teacher-parent-student cooperation. Each teacher agreed to take the time required for the instruction and inform the investigator when the unit had been taught and the students were ready to be tested.

Pattern I instruction was used for 158 students in 12 different schools, and Pattern II for 166 students in 14 different schools. A multi-stage procedure of random sampling was used for selecting and assigning the students to each instructional pattern. The schools were chosen from 197 departments of vocational agriculture in Pennsylvania, which had in common a number of characteristics related to farm mechanics.

The true-false test was administered by the investigator as a pre-test and post-test, the individual oral examination as a post-test only, and the check list of approved practices as a pre-evaluative and post-evaluative instrument. The null hypotheses concerning group differences between all students in the two patterns, and for the defined sub-groups, were tested at the .05 level by the t-test in terms of the three criterion measures.

There was a significant difference in true-false post-test mean scores, favoring Pattern II, for the all student group and for the student with access to tractor sub-group; but, there was not a significant difference for the student with safe tractor operation and maintenance improvement project sub-group. Comparative mean scores for the Pattern I and Pattern II all student groups were 68.2 and 69.8; for the student with access to tractor sub-groups they were 68.1 and 70.0.

There was a highly significant difference in oral examination mean scores, favoring Pattern II, for the all student group and for the student with access to tractor sub-group; but, there was not a significant difference for the student with safe tractor operation and maintenance improvement project sub-group. Comparative mean scores for the Pattern I and Pattern II all student groups were 56.5 and 70.4; for student with access to tractor sub-groups they were 55.9 and 70.4.

There was a significant difference in the approved practice check list post-evaluative mean scores, favoring Pattern II, for the student with access to tractor sub-group and the student with safe tractor operation and maintenance improvement project sub-group. Comparative mean scores for the Pattern I and Pattern II student with access to tractor sub-groups were 75.5 and 81.9; for the student with safe tractor operation and maintenance improvement project sub-groups they were 68.2 and 88.3.

It is concluded that Pattern II is superior to Pattern I in terms of the higher scores achieved for (a) subject matter knowledge, (b) performance skills and understanding of basic principles, and (c) approved practices adopted.

Microfilm $2.00; Xerox $6.80. 144 pages.

THE DEVELOPMENT OF BODE'S PRAGMATISM AND ITS INFLUENCE ON HIS PHILOSOPHY OF EDUCATION.

(L. C. Card No. Mic 59-4499)

Joseph James Chambliss, Ph.D.
University of Illinois, 1959

The thesis title indicates its principal objectives: to discuss the development of Bode's pragmatism, and to indicate the ways in which it influenced his philosophy of education. It is believed that a more nearly careful understanding of Bode's pragmatism, than is evident in his educational writings, is essential for understanding the main themes of his philosophy of education.

In 1905, Bode favored, tentatively, a kind of idealism, and criticized realism and pragmatism. A story is unfolded, from essays in philosophical journals, in which Bode talked himself out of idealism and into pragmatism. As he came to doubt the worth of assuming the transcendental in experience, he began to see the task of philosophy as the seeking of meanings in particular experiential situations. Bode's concept of purposive thought rejected the realism which holds that objects of knowledge exist prior to situations of thinking.

In his study of psychology, Bode came to hold a functional concept of mind. He echoed his objection to idealism by rejecting any "transcendental consciousness," and repeated his opposition to mechanistic realism by refusing behaviorism as an adequate explanation of consciousness.

After 1914, Bode turned increasingly from a defense of his pragmatic philosophy and functional psychology in terms of problems such as truth, knowledge, and consciousness per se toward an application of his philosophical ideas to concerns of specific situations "that dwell in the light of common day." By 1921, Bode had settled on education as the main discipline in which ideas developed from his philosophy and psychology were to function.

Bode's pragmatism as a way of life and his functional psychology became essential, in his philosophy of education, for considering the nature of aims to be sought and the nature of minds that are to be developed in the seeking. The philosophy of education, for Bode, was a discipline whose principal concern was to offer suggestions as ideas which, hopefully, will be turned into working hypotheses to be tried out in particular situations in the educational process.

Bode's philosophical ideas are discussed with respect to the following educational concerns: curriculum content and methods; education as a social and individual process; schooling as a specialized process in a social order of "democracy as a way of life"; the place of the "common man" in a democratic way of life; the kinds of meanings sought; and Bode's place in the progressive education movement.

It is pointed out how Bode's thinking was characterized

by an opposition to formalism. One consequence of Bode's protests against formalism was the absence, in his writings, of any single curriculum plan as a design for reconstructing the educational situation at large. This is not to argue that Bode was opposed to planning, however. It is more in the spirit of his thought to leave the planning to the uniquenesses of individuals, who hopefully can test different working-hypotheses, and develop forms which are not now conceived, rather than to suppose that a genuine learning process is likely to result within the bounds of already-established ones. Bode's faith in the possibilities of the intelligence of the common man taking form and making new forms was stronger than his faith in any form known.

It is thought that the value of Bode's philosophy of education, other than that indicated in this thesis, can be determined when, in actual educational situations, various hypotheses which would be in keeping with the spirit of his philosophy of education, are tested. The very logic of Bode's thought demands such tests, and a more nearly complete assessment of his philosophy of education awaits them. Microfilm $2.65; Xerox $9.20. 202 pages.

CONCEPT FORMATION IN FRESHMAN MATHEMATICS FOR ENGINEERS.

(L. C. Card No. Mic 59-4391)

Robert Eugene Horton, Ed.D.
University of Southern California, 1959

Chairman: Professor Calvert

The discovery of new mathematics directly applicable to engineering and the changes in applied mathematics techniques are forcing a re-examination of the engineering mathematics curriculum. This study was made to discover the detailed principles of curriculum development at the freshman mathematics level that could be used to reorganize the freshman course into one more closely related to the current needs of engineering students.

How can the content and organization of the freshman mathematics course be changed so that the mathematical concepts needed for modern engineering training will be available to the student at the time when he needs them?

A review of professional journals and college catalogs was made to determine the current status of the freshman mathematics program, recent trends in the mathematics curriculum, and the weight of opinion on integrated versus traditional course organization in mathematics. A review was made of dissertations relating to the mathematics needed by engineers in their college training and on the job. Additional dissertations on concept learning in mathematics were studied. Sources in the literature of psychology were examined for findings in learning theory related to mathematics.

Nine unified textbooks used in freshman mathematics were analyzed in terms of the basic mathematical concepts. A rank order correlation study was made of the agreement among the texts in the order of introducing the topics. An optimum sequence in terms of a least-square criterion was determined from the tests. Four recent textbooks emphasizing modern mathematics were analyzed, and the modern concepts identified.

From the findings of the foregoing, curriculum criteria were developed. Using these criteria, an outline for a freshman mathematics course was developed and submitted to a jury of authorities. From their comments, certain revisions were made. One unit of the course was developed in detail from the curriculum criteria.

Findings. All colleges examined required at least two years of mathematics for engineers. Most of them placed this mathematics in the first two years. The content included elements of mathematical analysis. Usually differential equations was the most advanced subject. Widespread opinion favors increasing the mathematics requirements for engineers and introducing some modern mathematics.

Six trends in the mathematics curriculum were identified. The weight of opinion favors unified freshman mathematics courses. The mathematical subjects used by engineers in training, and on the job, were identified.

Several research studies show the superiority of concept learning over memorization in producing desirable outcomes. Experimental data support the use of intellectual "crutches." Psychological research shows that there is an optimum learning order in terms of simple-to-complex concepts, and from broad concepts to details.

From the nine unified texts, seventy-nine basic concepts were identified. There is a significantly high agreement among the texts in the sequential order. The coefficient of concordance was .495. The pioneering texts devoted from 28 per cent to 100 per cent of their content to modern mathematics. Nineteen modern concepts were identified. The physics course affects both scope and sequence of the mathematics course. There is some agreement on the de-emphasis of certain traditional mathematical topics.

Conclusions. There should be more emphasis on elementary mathematical analysis, including some topics from modern mathematics. The freshman mathematics course should be of the integrated type and organized to produce concept formation. Concepts should be introduced intuitively first, then treated more formally later. Concepts should precede details. Certain useful intellectual "crutches" should be used in place of mathematical rigor. The course should be unified around the function concept, with certain basic analytical concepts providing the problem-solving structure.

Microfilm $4.25; Xerox $14.20. 330 pages.

A DECADE OF CURRICULAR CRITICISM OF PUBLIC SCHOOL EDUCATION IN THE UNITED STATES, 1948-1957.

(L. C. Card No. Mic 59-4871)

John E. Ingalls, Ph.D.
Bradley University, 1959

The purpose of this thesis was to give some assistance to those involved in educational criticisms--especially those criticisms of a curricular nature--by writing a brief history of curricular criticisms of public school education in the United States during the period from 1948 through 1957.

The criticisms were limited primarily to those contained within books, for two reasons. First, some work

has been done with criticisms as given in periodicals, and second, books afforded the length to offer the critics' ideas concerning curricular reform, which were also incorporated in the study. Another part of the thesis was devoted to representative appraisals of the criticisms by educators and laymen. It was hoped that the addition of these appraisals would add perspective and balance to the study.

The philosophical backgrounds of the curriculum were given, as an aid to help determine how important a role philosophical differences played in the criticism. The criticisms themselves were discussed under the following headings: (1) Neglect of the fundamentals, (2) Teacher training and the educationists, (3) Religion in the curriculum, (4) The curriculum for the gifted, and (5) Democracy in the curriculum.

On the elementary level, the critics charged that our schools were neglecting the three R's and were devoting too much time to activities which usurped the educative functions of the home, church, and other community agencies. Secondary education was criticized as a "watered-down" education; the critics advocated a program of fundamental studies for all secondary youth, which would include science, mathematics, history, foreign language, and English. At the university level, the critics believed that teacher training programs need to be revised, with the teacher trainee taking less education courses and more of the "fundamental" or "liberal" studies.

The critics were also of the opinion that public schools can have a good program of moral and spiritual values incorporated into the curriculum without violating the traditional separation of church and state or the principle of freedom of religion. They felt that much more needs to be done in preparing curricular programs for the gifted, and they called for a return of democracy, not only into the classroom, but also into the decisions involving curricular changes.

Educators and laymen studying the criticisms replied that many of the criticisms were the result of false reporting or of inadequate understanding of the area criticized. They called on the critics to formulate a philosophy of education which would be adequate to meet the needs of our public school system, and pointed out the results of research that showed that education during this decade was better than it had ever been. They called on those involved in curricular criticisms to organize citizen groups and keep the public informed of curricular developments. Microfilm $2.00; Xerox $5.00. 99 pages.

A STUDY OF DIRECTED CONCEPT FORMATION: THE TEACHING OF CONTEXT CLUES FOR VOCABULARY DEVELOPMENT.

(L. C. Card No. Mic 59-4930)

Roderick Airth Ironside, Ph.D.
University of Michigan, 1959

Vocabulary development is one concern of college-level reading improvement courses. One procedure which may be used in increasing vocabulary is to sensitize students to clues to meaning provided by the context for new words. This study reports an attempt to teach five contextual clues to students in the University of Michigan Reading Improvement Service in 1956. The problem was to determine which of three related teaching procedures is most effective in teaching these clues as verbal concepts.

A context clue is defined as a relationship among words which assists the reader in determining meanings for new words. While each context contains discrete clues, similarities among the clues are apparent. Thus, the term as used here refers to five categories of clues, suggested by McCullough, Strang and Traxler: definition, experience, comparison and contrast, synonym, and summary. These clues were treated as verbal concepts to be learned through directed classroom experiences.

For each of the five types of clues, twenty brief illustrative contexts were prepared. These examples, printed information, and lecture material were constructed for presentation in three different ways. A formal treatment study was designed, patterned in part on Hull's work with concept formation (Chinese characters). The hypotheses were as follows: 1. That subjects taught by the modified inductive method will show greater gains on a post-training test than will those taught, for the same length of time, by the inductive or deductive method, as measured by their ability to give correct meanings for stimulus words in context; and that subjects taught by the modified inductive method will show significant gains over a control group. 2. That subjects taught by the inductive method will make greater gains on a post-training test than will those taught deductively; and that subjects taught by the inductive method will make greater gains than a control group. Two comparable tests of context-using ability were constructed and validated to measure change in skill resulting from acquisition of the concepts. Each test was an article 1000 words long, containing 31 nonsense syllables of non-associative value to be defined by using the context.

After the initial context test, approximately one hour was spent in instruction in use of the context over a period of seven weeks. Classes taught deductively were lectured on the names and uses of the five clues; those taught inductively worked the 100 exercises without hint of clues or clue-names; combination deductive-inductive classes were given explanations and clue-names, and worked the exercises. Each of 5 instructors taught one class of each experimental group and on control group. These twenty classes contained the 211 students who constituted the total population.

The gains of the four groups were compared through determination of mean raw-score gains; through a multiple regression equation based on initial context test scores and vocabulary and comprehension results from a standardized reading test; through a comparison of gains made by below-median sub-groups; and through sub-groups equated on initial context scores and intelligence. While all groups made gains in test scores, no significant differences were found. Possible explanations for these negative results are the operation of a regression effect and failure to learn the clues as concepts, due in turn, perhaps, to insufficient training time.

Microfilm $2.25; Xerox $8.00. 172 pages.

A STUDY OF THE RELATIONSHIP BETWEEN AFFECTIVITY AND SCHOOL ACHIEVEMENT IN ELEMENTARY SCHOOL BOYS.

(L. C. Card No. Mic 59-4962)

William Hodges Mills, Jr., Ph.D.
University of Michigan, 1959

This is a study to determine the degree of relationship between school achievement and the general affective state of one hundred elementary school boys, as revealed in their cumulative records. Educational age, reading age, arithmetic age, spelling age, mental age, chronological age and intelligence were examined for covariance with three affective measures. Three types of affective scores were developed from the recorded behavior, which expressed the affective state of these boys during five and a half to nine years of attendance in the University School. The measures were: (1) total number of recorded items, (2) a ratio of positive to negative items, (3) a positive or negative percentage of total recording. The total sample was also divided into six sub-groups for separate analysis of extremes: over and under achievement, high and low intelligence, positive and negative affect, early and late starters, high and low achievers, and late starters but high achievers. Reliability and validity of the recorded affective behavior items was established by use of current literature, parallel reading, a panel of judges, use of several recorders, and an individual triple check of extracted items.

The three major hypotheses and related sub-hypotheses tested in this study were:

I. Affective state is measurable in the cumulative records kept by teachers in the University School.
   1. The larger the quantity of recording the lower is the affective state.
   2. The negative affective state is more frequently demonstrated than the positive affective state.

II. Affectivity and school achievement are related.
   1. Over achievers have high affective states.
   2. Under achievers have low affective states.
   3. Slow starters have low affective states.
   4. Early starters have high affective states.
   5. Positively loaded boys have high achievement.
   6. Negatively loaded boys have low achievement.

III. Affective state and intelligence are related.
   1. High I.Q.'s are associated with high affective states.
   2. Low I.Q.'s are associated with low affective states.

Hypotheses I, I_2, II and II_1 were very significantly supported at above the .05 level. Hypotheses I, $II_{2,3,4,5,6}$, III and $III_{1,2}$ were not statistically significant, but showed a suggestion of relationship by consistent supportive signs to the statistical statements.

Generally, affectivity is measurable in the cumulative record. Negative affective statements accumulate faster than positive affective statements. Intelligence is not associated by more than a chance relationship to the affective state. However, affectivity and school achievement are significantly and directly related. Arithmetic reveals an erratic relationship to affectivity, in that it sometimes has an inverse relationship to other types of school achievement.

A graphic presentation of individual affective development on a longitudinal basis is presented on growth charts, for visual examination with the achievement curves. The curve is plotted on the basis of the difference of + and - recording accumulated at six month intervals for the individual.

This provides a useful addition to the growth data for a better understanding of the individual child. Generally, these curves demonstrate: (1) early negative affective starts in school, (2) common fluctuations at about 108 months of age, (3) gradual reduction in quantity of total recording, (4) gradually improving net overt affective states. The change in direction of these curves appears more important than the absolute scores in the study of total growth. These behavior journals are so time consuming and expensive to collect, that their continuance is questionable for the low order of correlated affective information they contain.

Microfilm $2.00; Xerox $5.00. 98 pages.

THE TEACHING OF LITERATURE IN THE SENIOR HIGH SCHOOL: AN HISTORICAL AND CRITICAL STUDY OF RECENT TRENDS BASED UPON AN ANALYSIS OF SELECTED PROFESSIONAL PUBLICATIONS, 1911-1955.

(L. C. Card No. Mic 59-4966)

Dorothy Evelyn Moulton, Ph.D.
University of Michigan, 1959

This study is concerned with an educational controversy of the present century between conservatives, who regard the study of literature as a humanistic discipline, and progressives, who value literature chiefly for the contribution it can make to a program of training for citizenship. The history of the conflict as it affects the teaching of literature in the senior high school is traced by means of a critical analysis of selected professional publications: monographs of the National Council of Teachers of English, three groups of articles in The English Journal (major addresses by leaders of the National Council, editorials, and reports of classroom practice), twenty-one other professional periodicals, and a number of research studies published by professional organizations of national importance.

A survey of the professional periodicals indicates the vogue of progressive trends. The number of reports of conservative classroom practice appearing in The English Journal decreased from twenty-four in the five-year period 1925-29 to two in the 1935-39 period, whereas the reports of progressive practice increased in the same periods from four to twenty. In the 1945-49 period, reports describing successful progressive methods outnumbered the descriptions of conservative methods by a ratio of almost three to one. In a space of thirty-one years (1925-55), twenty-one professional periodicals other than

The English Journal published only thirty-four articles on the teaching of senior high school literature. Twenty-five of these are examples of progressive methods, eight represent a compromise, and only one reflects the conservative point of view. The research studies of professional organizations reveal equally strong progressive trends. Thus there has been an imbalance in the representation afforded to the opposing sides of the controversy.

The application of progressive methods to the teaching of literature began in the third decade of the century with the adoption and adaptation of Herbert Morrison's unit technique, the forerunner of the core curriculum, which developed during the thirties. The integrated or core curriculum gave progressives an opportunity to put into practice the problem-solving methods of education-for-democracy which John Dewey described and advocated. Conservative critics allege that in the core curriculum, in which social aims, social materials, and socializing methods are paramount, the traditional values of literature study are in danger of being lost. The extent of the influence of the core curriculum upon the study of literature has not been determined, for the available statistics tell only a small part of the story. It is certain that comparatively little effort has been made to test by means of controlled experimentation the relative merits of progressive and conservative methods of literature instruction in the senior high school. Of 161 descriptions of classroom procedures published over a period of thirty years (1925-54), only eight were reports of controlled experiments.

In the present decade Americans have been taking a second long look at their public schools. One result is that the place of the traditional subjects in the curriculum, including English studies, is being re-examined, and dissenting opinions of the position to which literature is relegated in integrated programs are being heard. Not only conservatives but also moderate progressives are restating the values of the study of literature. As the two sides of the controversy sincerely work for an understanding of each other's points of view, teachers of literature may yet achieve a degree of harmony that will be salutary for their profession.

Microfilm $5.05; Xerox $17.00. 396 pages.

IMPLICATIONS OF RECENT ATTITUDE RESEARCH FOR THE ACHIEVEMENT OF CERTAIN ATTITUDINAL OBJECTIVES OF SECONDARY SCHOOL ENGLISH.

(L. C. Card No. Mic 59-4578)

Ralph Henderson Thompson, Ed.D.
University of Illinois, 1959

The study had as its purpose the derivation of principles for the achievement of certain attitudinal objectives of secondary school English from a review of recent attitude research. Approximately one hundred seventy-five studies of attitude were reviewed and the generalizations supported by them were stated. Objectives related to attitude were selected from a number of influential listings of objectives of secondary school English. The implications of attitude research for the achievement of the attitudinal objectives were stated as principles.

Seventy-six detailed generalizations appearing under six broad generalizations were drawn from the review of recent attitude research. The six major headings under which the detailed generalizations appear are as follows: definition, environmental factors, personality factors, intellectual factors, communication and influence, and prejudice. The review of the research was reported as supporting the following conclusions: (1) attitudes are learned from experience and are maintained by factors in the environment and personality; (2) they involve affective, cognitive, and conative factors, any one of which may be salient depending upon the circumstances; (3) social factors, such as child-rearing practices, the social milieu, peer group affiliations, and group pressures will affect attitudes; (4) the concept of self and the ego-defensive strategies used seem to affect which attitudes will be developed and maintained; (5) all learning seems to be affected by attitude, information appearing to be more often a result than a cause of attitude; (6) communication and influence situations involve four elements: the receiver, sender, communication, and setting, any one of which may be salient; and (7) prejudice as a wide-spread attitudinal phenomenon, is closely associated with environmental and personality factors which make it difficult to modify.

Statements of behavior pertinent to secondary school English were used as the means for selecting attitudinal objectives from five reports of the National Council of Teachers of English, three reports of other national groups, five reviews of courses of study, five city courses of study or curriculum guides, and three textbooks in the teaching of secondary school English. Forty-one percent of the attitudinal objectives were classified as dealing primarily with enjoyment of aesthetic and artistic activities and with appreciation. Each of the seven other categories was reported as including from 5% to 12% of the attitudinal objectives which were reviewed. The infrequency with which attitudinal objectives for written composition appear was noted. Reference was made to the form in which attitudinal objectives appear in the sources and to the infrequency with which procedures for attaining them were stated.

A framework of principles for the achievement of certain attitudinal objectives of secondary school English was derived from the implications of the attitude research. The following types of general principles were set forth: wholeness, perceptual selectivity, salience, multiple causation, differential response, unearned increment or decrement, and patterning. Principles of cognition which were reported were classified as follows: independence and interdependence, generality and specificity, form, exposure, and cognitive restructuring. Principles of affect were classified under the following topics: self-concept, ego-defensive strategies, and stress. Principles of social behavior were stated under the following topics: involvement, status, and norms. And principles of judgment appeared under the following headings: stereotypes, origins, and content. Following an explanation of each principle, reference was made to the connections

between the attitudinal objectives and the attitude research. Each principle was illustrated with at least one classroom practice. Microfilm $2.50; Xerox $8.80. 191 pages.

THE RELATIONSHIP BETWEEN PERSONALITY TRAITS AND BASIC SKILL IN TYPEWRITING.

(L. C. Card No. Mic 59-4476)

Woodie L. Tucker, Ph.D.
University of Pittsburgh, 1959

This study has a primary purpose of determining the degree of relationship between certain personality traits and success or failure in learning to typewrite and a secondary purpose of ascertaining the degree of relationship between I. Q.'s. of the individuals studied and success or failure in learning to typewrite.

To achieve these purposes, three five-minute straight-copy timed writings were given to 450 first-year typewriting students in Norfolk County, Virginia. The best one of these three writings, scored in terms of net words per minute, was used to place the subjects on an achievement scale. The top and the bottom 10 per cent of the subjects on this achievement scale were classified as successful and unsuccessful typists, respectively.

To the dichotomy of successful and unsuccessful typists were administered the Edwards Personal Preference Schedule, the Guilford-Zimmerman Temperament Survey, and the California Test of Mental Maturity, Long Form. The bi-serial method of correlation was used to show the relationship between scores on these tests and success or failure in typewriting. The results of these procedures are summarized as follows:

There was a positive and significant correlation between scores on all parts of the California Test of Mental Maturity and success in typewriting.

From scores on the Edwards Personal Preference Schedule was obtained a significant negative correlation between the trait called "Aggression" and success in typewriting. None of the remaining 14 traits correlated significantly with either success or failure.

From scores on the Guilford-Zimmerman Temperament Survey were obtained significant positive correlations between success in typewriting and the factors called "Restraint" and "Personal Relations." None of the remaining eight factors produced a significantly high correlation in either direction.

The findings of this study indicate that there may be a significant relationship between certain personality traits and success or failure in typewriting. These findings also indicate that a positive relationship does exist between intelligence and success in typewriting.

Microfilm $2.00; Xerox $4.00. 73 pages.

ENGINEERING, GENERAL

A MATHEMATICAL MODEL FOR PRODUCTION SCHEDULING.

(L. C. Card No. Mic 59-4127)

Andre Ernest Bindschedler, Ph.D.
Purdue University, 1959

Major Professor: Dr. Paul H. Randolph

The purpose of this thesis is to construct a mathematical model for the scheduling or sequencing of industrial operations in intermittent manufacture. In this type of production, the products are processed in lots or batches, each of which must undergo a series of operations on a certain number of machines in the order specified by the routing of the lot. Due to limited machine capacities, various lots compete for available productive time and must be sequenced in such a way that: (1) the operation order specified by the routing is respected; (2) the machine loads are within available capacities; and (3) a specified objective function is optimized. This, in essence, is the scheduling problem.

The approach involves three steps: (1) the establishment of a mathematical structure, i.e., a definitional framework, for the problem, (2) the establishment of a value system for the evaluation, comparison, ranking and selection of schedules, and (3) a systematic procedure, or algorithm, for the determination of the best schedule.

The mathematical structure is developed in two steps: first a simplified model is established on the basis of rather restrictive assumptions; then, through appropriate extensions and modifications, the model is generalized and made applicable to the majority of scheduling situations. The basic approach involves both a "mathematical Gantt Chart" in matrix form and a geometric construction of "program lines" in hyperspaces; both of these methods result in identical schedules. They define sets of alternative sequences in a combinational frame work. Technologically unfeasible programs can be recognized by constructing the corresponding "operation queue" which, in essence, is an expanded program satisfying the technological sequencing restrictions for the production lots involved.

For the establishment of the value system, the important factors contributing to the overall evaluation of schedules are defined in the form of mathematical criteria. The values of criteria corresponding to a particular program are obtainable by calculation from the mathematical structure of the model.

Formulae are presented for the following criteria: delivery within due dates, various penalty schemes for late deliveries, lot priorities, minimax delay, minimum overall fabrication span, minimum in-process inventory, maximum machine utilization and storage restrictions. The relationship between two criteria may fall in one of three categories: it may be a "comparability", a "dependency" or a "dominance" relationship. Comparable criteria are combined into a composite criterion by a linear weighting scheme. In the cases of dependent criteria, a new conditional criterion is defined as the combined effect of its component criteria. Dominant criteria are defined as the components of a multi-dimensional utility function, U. Scheduling, therefore, becomes a multi-criteria decision process. Among the entire set of programs G, the best one is the program i for which:

$$U(i) = \max_{n \in G} [U(n)]$$

The algorithm is based on a sequential procedure which yields successive monotonely improving approximations. Two practical methods are presented which result in a considerable reduction of the computational work. One is based on the systematic construction of possibly optimal programs and the other on the reordering of computational steps based on set theoretical considerations. Both the mathematical structure and the value system are illustrated by examples.

The results of this thesis can be summarized as follows: (1) the proposed model structure permits a mathematical formulation of the general scheduling problem. Since it closely follows the present industrial practice (therefore the name "Mathematical Gantt Chart"), it is applicable to almost all Gantt chart scheduling situations; (2) the proposed value system is extremely flexible. It can include several evaluation criteria and be adapted to other mathematical structures. (3) The proposed algorithm furnishes good approximations if computational shortcuts are used, and leads to the optimal program if all possibly optimal programs are evaluated.

In summary, this thesis furnishes a quantitative and rational approach for the scheduling problem which will, it is hoped, replace the judgement and intuition that are predominantly used today in practice.

Microfilm $2.65; Xerox $9.20. 203 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

ENGINEERING, AERONAUTICAL

ON THE VIBRATIONS OF HEATED CYLINDERS AND PLATES.

(L. C. Card No. Mic 59-4167)

Vadilal J. Modi, Ph.D.
Purdue University, 1959

Major Professor: Dr. Hsu Lo

The dynamic characteristics of heated cylinders and plates having temperature gradient across the thickness are investigated here.

In the case of the cylinder the frequency equation is derived taking into account the variation of the modulus of elasticity and Poisson's ratio with temperature. The possibility of existence of a similarity law between the vibration of heated and unheated cylinders is examined. It is shown that similarity between the two cases can be established in a particular case of the unpressurized cylinders with Poisson's ratio assumed constant. For a numerical example a thin Inconel-X cylinder with the outside maintained at room temperature and the inside heated to 1800°F is considered. Frequency spectra and vibration modes are plotted for this particular case for both pressurized and unpressurized cylinders. Reductions in frequencies at this high temperature for various combinations of circumferential nodes and axial wavelengths are also presented.

In Part II the vibration and buckling of heated plates with various boundary conditions is considered. It is shown that the frequency of vibration and buckling loads are related when the plate is subjected, at its edges, to a uniform moment the magnitude of which depends upon the temperature gradient.

Microfilm $2.00; Xerox $5.40. 106 pages.

ON THE APPLICATION OF THE STABILITY THEORY OF DIFFERENTIAL SYSTEMS TO THE STABILITY OF MOTION OF A MISSILE.

(L. C. Card No. Mic 59-4553)

Lembit Pottsepp, Ph.D.
University of Illinois, 1959

In the usual approaches to the stability of motion of aircraft, missiles and spinning projectiles, the equations of motion are linearized by small perturbation techniques. The resulting equations are linear differential equations with constant coefficients and the stability criteria are readily reducible from the solution of these equations.

The present investigation considers the stability of motion of a missile with rotational symmetry and a plane of mirror symmetry. The aerodynamic coefficients are assumed to be functions of the distance along the trajectory consisting of a constant and a variable part.

It is demonstrated that by utilizing well known results from the stability theory of differential equations, it is possible to obtain stability criteria without solving the equations of motion.

The derived stability criteria indicate the following:

the constant parts of the coefficients must satisfy inequalities precisely analogous to those obtained in the case of constant aerodynamic coefficients;

the sum of the magnitudes of the variable parts of the coefficients must be less than a given constant which depends upon the constant parts of the coefficients.

These criteria were applied to a cone with zero spin in hypersonic flow and a missile with moveable control surfaces. In the case of the cone, the aerodynamic coefficients were computed from the Newtonian approximation of hypersonic flow. As a consequence of the analytical representation for the coefficients, the stability criteria obtained were explicit and showed that the cone is stable provided:

the tangent of the semivertex angle is less than $1/\sqrt{2}$;

the center of gravity is ahead of the center of pressure;

the absolute value of the angle of attack is less than a given constant which depends upon the vertex angle of the cone, the transverse radius of gyration, the ratio of the distance between the center of gravity and the center of pressure to the height of the cone and the ratio of air density to the average density of the cone.

Microfilm $2.00; Xerox $4.20. 77 pages.

ON CERTAIN FUNDAMENTAL CONCEPTS OF CLASSICAL AND QUANTUM KINETIC THEORY OF GASES.

(L. C. Card No. Mic 59-4585)

Clive Gordon Whittenbury, Ph.D.
University of Illinois, 1959

The formal basis of a new method in the kinetic theory of gases is developed which may be applied to a quite general class of many particle systems. The method, which is founded upon the formalism of quantum mechanics, is applicable to systems in which particle interactions describable by means only of quantum mechanics occur. The description of classical systems is included in the method as the classical limit of the quantum formalism. The method allows a separate consideration of the various types of interactions that may occur, such as two-body, many particle, atomic and nuclear reactions, but combines the effects of these interactions in a system of simultaneous equations. This system of equations provides a natural mathematical basis for the construction of models to describe any particle system. One model in particular is considered, in which both many particle weak interactions and strong two-particle interactions occur.

The method is founded upon the concept of a truncated distribution function, which is a reduced distribution function in which the domain of integration of the reduction integral covers a restricted or truncated domain of the phase space accessible to all particles in the system.

In addition to the system of equations describing a quite general class of particle systems, the derivation of the classical Boltzmann equation is considered, and a new derivation of the quantum mechanical equivalent of the

Boltzmann equation is given in terms of the truncated distribution function.

The above equations are derived in a rigorous manner from Liouville's equation, for the classical case, and Wigner's equations, for the quantum case, and are considered to possess several advantages over previous derivations from both a physical and mathematical point of view. Microfilm $2.00; Xerox $6.80. 144 pages.

SOME MATHEMATICAL ASPECTS OF TIME-DEPENDENT FLOWS—PROPERTIES OF THE TRANSFORMATIONS OF ONE-DIMENSIONAL, UNSTEADY FLOW EQUATIONS.

(L. C. Card No. Mic 59-4588)

James Xerikos, Ph.D.
University of Illinois, 1959

In the present paper, three distinct fluid dynamic topics are treated which are related in that time dependence of the flow is an essential feature of each.

At first a three-dimensional, compressible, unsteady diabatic flow is considered. In the formulation of diabatic flow theory, the heat energy, Q, may be thought of as being introduced into the fluid by a spatial distribution of heat sources and sinks. An expression for the time rate of change of circulation is derived. The resulting expression is essentially a form of Kelvin's theorem for diabatic flow. Owing to mathematical restrictions arising in the derivation, Q is required to possess a perfect differential as opposed to the less restrictive requirement of possessing a total differential.

Next some kinematical aspects of the unsteady flow of a two-dimensional, incompressible fluid are treated where time plays the role of a parameter. Using the notion of a time-dependent complex potential whose real and imaginary parts are, respectively, the velocity potential, $\varphi(x, y; t)$, and stream function (or, more correctly, the particle function) $\psi(x, y; t)$, the mathematically acceptable forms that the harmonic functions φ or ψ may take on are investigated. By considering the general integral of Laplace's equation for φ, in addition to finding a particular solution, it is seen that these forms are more general in nature than the usual representation as a separable function of time and space variables.

The major portion of the paper is concerned with the properties of the linearizing transformations of one-dimensional, isentropic, unsteady flow. The transformations are carried out using $\varphi(x, t)$ and $\psi(x, t)$ as dependent variables in lieu of the usual practice of employing the fluid velocity and speed of sound as dependent variables. This is done primarily in an effort to demonstrate any practical limitations in the use of the time-dependent velocity potential, $\varphi(x, t)$, which has neither the simplicity of definition nor the symmetrical mathematical properties of its steady, two-dimensional counterpart, $\varphi(x, y)$.

A formal proof establishing the non-vanishing of the Jacobian of the transformations is carried out under assumptions which define differentiability conditions for the dependent variables in the transformed plane. Although the conditions correspond to the usually accepted properties of isentropic, fluid flow systems, there is an open question as to what may happen if these conditions are not met. The possibility of the existence of a limiting line is therefore admitted and an investigation is carried out to establish the behavior of particle lines and characteristic lines in the neighborhood of a limiting line. The results parallel those obtained for the steady, two-dimensional flow case, e.g., particle lines have cusps and are turned back at a limiting line.

Microfilm $2.00; Xerox $4.40. 81 pages.

ENGINEERING, AGRICULTURAL

THE EFFECT OF WORK-LOAD AND ENVIRONMENT ON SOME PHYSIOLOGICAL RESPONSES IN MAN.

(L. C. Card No. Mic 59-4696)

Charles Wilson Suggs, Ph.D.
North Carolina State College, 1959

Supervisors: William Eldon Splinter and Francis Jefferson Hassler

A series of laboratory experiments was run to evaluate the major physiological responses of humans to work-loads under different environments. The responses evaluated were heart rate, ventilation rate, oxygen consumption rate and mechanical efficiency. In the laboratory known work-loads were imposed by means of a bicycle ergometer, and controlled conditions of temperature, relative humidity and thermal radiation were available inside an insulated test chamber. Work-load was varied from 1200 to 6600 foot-pounds per minute, temperature from 44° to 106°F., relative humidity from 30% to 100% and thermal radiation from ambient to a mean radiant temperature of 158°F. The lower work-load is light and the upper one heavy but not severe.

From an experiment involving various work-loads at constant environment it was found that heart rate was approximately linearly related to work-load. Contrary to the implications of the literature, the slope of the regression line was found to vary among the population. Variation was from 0.0100 to 0.0197 strokes per foot-pound. Heart rate did not rise fast enough with work-load to explain the increase in oxygen transport which occurred. A second mechanism called oxygen pulse or the quantity of oxygen consumed per heart stroke was found to be active. This quantity was evaluated and shown to increase linearly with work-load.

Temperature, relative humidity, and work-load were investigated simultaneously so that the interactions might also be evaluated. A four dimensional polynomial prediction equation containing squared terms and interaction terms was fitted by the method of least squares to each of the responses. The responses measured were heart rate, ventilation rate, oxygen consumption rate and mechanical efficiency.

The first three of these response hypersurfaces are quite similar, the dependent variable in each increasing

with respect to both temperature and work-load and the major effect of humidity appearing as an interaction. The effect of humidity is such that these responses are increased when both temperature and humidity are at the same extreme. Extremely high or low temperatures further lowered these responses. Although the coefficients of the work-load variable in all of the equations are small, the effect of work-load was two to three times as large as that of temperature. This is due to the fact that numerically the work-load scale values were about 75 times larger than those of temperature and humidity.

Mechanical efficiency ranged from 17.5% to an unexplainable high of 63.7%. The mean response was 32.6% which indicated that work on the bicycle ergometer was slightly more efficient than other types of exercise. Efficiency at any given level of humidity was highest in the area of low temperature and high work-load and second highest in the area of low work-load and high temperature. The two conditions for which heat dissipation was of greatest concern gave lowest mechanical efficiencies; they were (1) high work-load, high temperature and (2) low work-load, low temperature.

Thermal radiation was found to elicit a heart rate increase but no ventilation rate change. Subjectively, thermal radiation was considered to be a significant physiological strain.

A series of field experiments was run to demonstrate the application of heart rate and ventilation rate responses as two techniques for evaluating unknown work-loads and to evaluate the equivalent work-load of several farm tasks. The results contained the variability common to field data but gave means which were both self consistent as well as consistent between the two techniques. The following values were found:

Task		Work load ft.-lbs./min.	Energy Cost
Transplanting tobacco:	Machine	616	18.2 ft.-lbs./plant
	Hand setting	1108	69.2 ft.-lbs./plant
	Hand dropping	721	45.1 ft.-lbs./plant
Priming tobacco:	Riding	1200	12 ft.-lbs./leaf
	Walking	2750	27.5 ft.-lbs./leaf
Looping		990	31 ft.-lbs./bundle
Handing		425	16.5 ft.-lbs./bundle

Static forces were exerted and the cost measured. The results showed that energy cost was correlated with the torque exerted by the muscle rather than with the magnitude of the force. Forces were also applied in such a manner that muscles were required to resist a motion. Energy cost of this type of activity (negative work) was found to be equal to about one-fifth of the work done on the muscle.

Electrical circuit analogs of body temperature and heart rate regulation were designed and analyzed. The analysis based on the temperature analog showed how body temperature deviation could account for the cooling mechanism operating at different levels depending on needs. The heart rate analog gave an exponential term involving time as a variable plus a fractional power of time both of which are consistent with experience.

Microfilm $2.30; Xerox $8.20. 176 pages.

ENGINEERING, CHEMICAL

RESIDENCE-TIME DISTRIBUTIONS OF SHORT TUBULAR VESSELS.

(L. C. Card No. Mic 59-4288)

Robert J. Adler, Ph.D.
Lehigh University, 1959

When a fluid stream flows through a vessel at a constant rate, the residence time (time of passage) varies from molecule to molecule. In the aggregate the situation is described by a distributive function. A knowledge of this function is necessary for the optimum design and operation of many types of continuous-flow process equipment.

The residence-time distribution can be found analytically under certain conditions. Solutions are given for the cases of perfect mixing (homogeneous vessel contents), laminar flow with negligible diffusion in tubes, very turbulent flow with negligible diffusion in tubes or packed beds, and extremely long tubes regardless of the nature of the flow.

Little is known about the residence-time distribution of short tubular vessels equipped with concentrically positioned, small diameter inlet and outlet ports, and this class of vessel is investigated experimentally.

Dimensional analysis of the Navier-Stokes Equation coupled with additional physical reasoning shows that three dimensionless parameters should approximately characterize these systems and may provide a sound basis for scaling the results of experiments. These dimensionless parameters are the length to diameter ratio of the vessel, the Reynolds Number, and the vessel diameter to port diameter ratio. The values of these dimensionless parameters studied were: length to diameter ratio 2, 5, and 10; Reynolds Number (based on inlet port diameter) 1,000, 2,000, 4,000, 7,000, 10,000, 15,000, and 25,000; vessel diameter to port diameter ratio 5, 10, and 20.

The experimental equipment, which is fully described in the body of the report, consists of an electronically controlled valve for injecting tracer (black dye) into the inflowing stream, a flow-through colorimeter for monitoring the concentration of tracer in the outflowing stream, and other lesser controlling and measuring devices.

The experimental results are summarized in the body of the report in tabular and graphical form, and very extensive and detailed data are contained in the Appendix.

Approximately 200 different runs were made under about 65 different operating conditions. Most of the runs were made with water in 6" diameter tubes, but a few runs were made with a higher viscosity fluid, 40% sugar solution, and a few runs were also made with a different diameter tube, 4".

Over the range of variables studied, the length to diameter ratio of the vessel seemed to be the most important of the three dimensionless parameters.

For very short vessels, about length to diameter of two, the time at which the highest point on the residence-times distribution curve occurs was successfully correlated with a semi-theoretical equation based on free jet theory, using all three of the dimensionless parameters mentioned above.

An interesting characteristic of all of the systems studied in this report is the exponential nature of the decaying portion of the residence-times distribution curve. A simple model is proposed to explain this exponential decay and other characteristics possessed by the residence-times distributions of short vessels.

Microfilm $3.25; Xerox $11.00. 249 pages.

LIQUID AND GAS-PHASE MASS TRANSFER ON BUBBLE-CAP TRAYS.

(L. C. Card No. Mic 59-4884)

John Wesley Begley, Ph.D.
University of Michigan, 1959

This investigation was made for the purpose of studying the effects of liquid properties in the high ranges of viscosity and density upon rates of mass transfer on bubble-trays.

The equipment used in this investigation consisted of a 7 1/2 x 12-inch rectangular tray equipped with 9, 1 1/2-inch diameter, bubble caps located on a 2 1/2-inch rectangular spacing. The systems used were chosen so that the effects of the liquid properties upon the gas and liquid-phase resistances could be studied separately. Adiabatic vaporization of cyclohexanol (high viscosity) and ethylene dibromide (high density) was used to study the gas-phase resistance. The liquid-phase resistance was studied by absorbing pure carbon dioxide in cyclohexanol. The bulk hydraulics of the two-phase system on the tray were also studied and these data were used in the interpretation of mass transfer by use of mathematical models developed previously.

The gas-phase mass transfer coefficients $k'_G a$ together with values from the literature correlated as follows:

$$k'_G a = 523.9 \frac{D_G^{0.53}}{\rho_L^{0.83}} \frac{(\text{F-factor})^n}{(Z_f - Z_c)^{0.28}}$$

where $n = 0.85(\mu_L/\rho_L)^{0.24}$

The ranges of variables represented by the data used in the correlation are as follows:

gas density; ρ_G	:	0.0130 - 0.2737 lb/ft^3
gas viscosity; μ_G	:	0.0351 - 0.0485 lb/ft-hr.
gas diffusivity; D_G	:	0.210 - 4.22 ft^2/hr.
liquid density; ρ_L	:	48.7 - 134.2 lb/ft^3
liquid viscosity; μ_L	:	1.45 - 58.1 lb/ft-hr.
F-factor, $U_s\sqrt{\rho_G}$	:	0.2 - 1.2
gas holdup; $Z_f - Z_c$	:	0.16 - 0.80 ft
liquid rate	:	4.6 - 32.0 gpm
weir height	:	1 1/2 - 3 1/2 inches

The liquid-phase mass transfer coefficients determined by a previous study with this equipment for the absorption and desorption of carbon dioxide in water and the data for the absorption of carbon dioxide in cyclohexanol were found to correlate as follows:

$$k_L\bar{a} = \beta' D_L^{1/2} (\mu_L/\rho_L)^{\alpha} (\text{F-factor})^{0.58}$$

where β' and α are functions of μ_L/ρ_L

In the range of kinematic viscosity greater than 1.0 ft^2/hr., the value of α was found to be minus 0.5. Below the value of 1.0 ft^2/hr., α decreases and approaches zero as kinematic viscosity approaches the value of 0.01. The variation of β' and α with kinematic viscosity is indicated graphically in the text of the dissertation. The ranges of variables represented by the data used in the correlation are as follows:

liquid viscosity; μ_L	:	2 - 235 lb/ft-hr.
liquid density; ρ_L	:	58 - 62.4 lb/ft^3
F-factor; $U_s\sqrt{\rho_G}$	:	0.3 - 2.2
liquid rate	:	4.6 - 32.0 gpm
weir height	:	2 - 3 1/2 inches

Variations in liquid density, viscosity, and surface tension were not found to have a significant effect upon the bulk hydraulic characteristics; however, correlations are included to show the minor effects of the foregoing variables upon froth height, clear liquid height, and gas holdup. Microfilm $4.45; Xerox $14.80. 345 pages.

PREDICTION OF GAS STORAGE RESERVOIR BEHAVIOR.

(L. C. Card No. Mic 59-4897)

Keith Hal Coats, Ph.D.
University of Michigan, 1959

The purpose of this research has been the development of fundamental theory relating to the performance of gas storage reservoir-aquifer systems and evaluation of this theory by application to actual gas field studies. Several sub-problems were studied in order to attain this general purpose. Thus the specific objectives of the research were 1) development and application of a general digital computer method of predicting the pressure and volume behavior of a storage reservoir subjected to an arbitrary time-variant gas injection-production schedule; 2) development and application of a method of determining the "effective" values of reservoir physical constants, i.e. those values which result in best agreement between the

calculated and actual field performances; 3) an investigation of the effect of reservoir geometry on the field performance, including development of a numerical method of solving the diffusivity equation (governing unsteady state liquid flow in porous media) in elliptic coordinates and use of this method in drawing a comparison between the performances of gas fields of elliptic and circular boundaries; 4) development and application of methods to treat the special problems of interference between gas fields, non-uniformity of the aquifer initial pressure distribution, and growth of the gas bubble radius with time in "aquifer storage" operations. ("Aquifer storage" denotes the injection of gas into an aquifer formation originally containing no gas.)

Data were obtained from three Michigan gas fields and two aquifer storage reservoirs in order to evaluate the predictive accuracy and field applicability of the methods developed in the research. All computations were programmed in the FORTRAN code and performed by the General Motors' IBM 704 computer in Detroit or were programmed in the IT compiler code and performed by the IBM 650 computer at the University of Michigan.

The agreement obtained between calculated and observed reservoir performances indicates that both the accuracy and applicability of the developed methods are more than adequate for present engineering needs. The results justify, in the cases considered, the treatment of aquifers (underground water-bearing formations) as porous, homogeneous, thin disks of large or infinite extent in the radial (horizontal) direction. The use of digital computers in conjunction with analytical and numerical solutions to the equations governing unsteady state water flow has allowed in this research, for the first time, treatment of reservoir problems previously unconsidered because of the prohibitive volume of calculations involved. The methods developed in the research appear to be useful tools for those seeking better ways of understanding, analysing, and predicting gas storage reservoir performance.

Certain problems must be considered further before the ultimate goal of ability to accurately predict the performance of any gas storage reservoir is achieved. Analytical solution of the diffusivity equation in elliptic coordinates will allow definite and final conclusions concerning the errors involved in approximating elliptically shaped reservoirs as equivalent circles for the purpose of predicting the field behavior. Numerical evaluation of a developed analytical solution to the diffusivity equation in one horizontal and one vertical spatial coordinate will allow prediction of the performances of gas reservoirs situated on top of very thick aquifers.

Microfilm $3.15; Xerox $10.80. 241 pages.

VAPOR-LIQUID EQUILIBRIA: THE SEPARATION OF FORMIC ACID-ACETIC ACID-WATER MIXTURES VIA AZEOTROPIC DISTILLATION.

(L. C. Card No. Mic 59-3623)

James J. Conti, D.Ch.E.
Polytechnic Institute of Brooklyn, 1959

Adviser: Donald F. Othmer

The general objective of this research was to investigate the phase equilibria of systems which undergo azeotropic distillation, in order to gain an insight into the distillation mechanism. Specifically, a solvent was to be found that could function as an entrainer in the selective recovery of acetic and formic acids via azeotropic distillation.

Solvents from a specially compiled list considered as promising entrainers were tested as such in laboratory batch fractionation columns adapted for azeotropic distillation, using synthetic charges of aqueous acid solutions. A new "adiabatic" Othmer vapor-liquid equilibrium still was successfully tested and further modified for the investigation of the equilibria of systems involving partially-miscible liquids. Mixing of the pot liquid was accomplished by a thermal mechanism similar to the thermosiphon, while the condensate holdup was made homogeneous in a specially designed trap via high-speed mechanical agitation.

Chloroform was found to be the most effective entrainer for the recovery process. The phase equilibria of the binary and ternary systems for the components acetic acid, formic acid, water, and chloroform were investigated and graphically correlated. Molecular association complicates the thermodynamic interpretation of the equilibrium data of systems containing formic acid or acetic acid, but the use of pseudo-molecular weights facilitates this interpretation.

The developed equilibrium data can be used to calculate the number of theoretical stages required to effect a given separation and illustrative calculations of this nature have been made. With the aid of a Hausbrand diagram it is shown how, for example, chloroform functions as an entrainer in de-watering aqueous acetic acid.

Microfilm $3.20; Xerox $11.00. 246 pages.

EXPERIMENTAL DETERMINATION OF THE THERMODYNAMIC PROPERTIES OF GASES AT LOW TEMPERATURES AND HIGH PRESSURES.

(L. C. Card No. Mic 59-4905)

Richard Campbell Faulkner, Jr., Ph.D.
University of Michigan, 1959

The purpose of this work was to (1) design and construct equipment suitable for determining experimentally the enthalpy of light hydrocarbon mixtures over the temperature range from 70°F to -280°F, over the pressure range from atmospheric to 2500 psia, (2) mechanically test and calibrate the equipment, and (3) obtain sufficient data on a gaseous substance to evaluate tne performance of the system.

In order to deliver fluid to a flow calorimeter or expansion device at a specified temperature and pressure, a compressor for circulation, equipment for continuous purification, means for stabilization and control of pressure and flow rate, and a cooling system employing dry ice and liquid nitrogen, were incorporated in a closed flow cycle. A linear flow meter was installed on the intake side of the compressor in a portion of the system operating at ambient temperature and at pressures from 60 to 100 psia. The flow meter was placed in a constant temperature liquid bath.

A high pressure flow calorimeter was constructed to measure isobaric specific heats of liquids, gases, or single phase systems above their critical pressures, and to measure isobaric integral latent heats of vaporization of mixtures. An expansion device employing radial porous plugs, often described as a Joule-Thomson throttle, was constructed to measure isenthalpic throttling.

Both the calorimeter and expansion device were located in a constant temperature liquid bath. The temperature of the bath was measured with a platinum resistance thermometer. A pressure balance was installed for measuring absolute pressures or pressure differences at the calorimeter or expansion device. An electronically regulated DC power supply, having a capacity of 60 watts, furnished the energy for calorimetric measurements at 0 to 100 volts. Electrical energy to the calorimeter was measured with a potentiometer, standard resistors, and attendant circuitry. Multiple junction copper-constantan thermocouples were provided for measuring temperature changes in the calorimeter or expansion device.

Prior to taking measurements the flow system, calorimeter, and expansion device were mechanically tested and calibrations were performed for the measuring devices including the flow meter and calorimeter thermocouple.

The flow system and calorimeter were operationally tested by measuring the isobaric specific heat of nitrogen at pressures from 294 to 1176 psia and temperatures from -50°F to -150°F employing mass flow rates from .16 to the maximum system flow rate of .30 pounds per minute. Measured energy additions ranged from .9 to 2.9 Btu's per minute, causing a temperature rise of 18 to 20°F for the fluid.

The majority of the experimentally measured values of the isobaric specific heat of nitrogen agreed with literature values within 2%. An evaluation of the individual measurement errors indicated a maximum uncertainty of 0.7% in mass flow rate, energy addition 0.1%, temperature rise of the fluid 0.3%.

Based on experience gained during operation of the equipment, it was concluded that modifications should be undertaken by the next investigator to reduce the length of time required to obtain data and to eliminate sources of inaccuracy which became apparent. It is believed that measurements of isobaric specific heats of light hydrocarbon mixtures from 70°F to -280°F, from atmospheric pressure to 2500 psia with an accuracy of 1%, or better, would then be possible.

Microfilm $3.75; Xerox $12.60. 289 pages.

CONTROL OF VAPOR AND LIQUID PHASE FLOW IN PACKED AND PLATE FRACTIONATION TOWERS.

(L. C. Card No. Mic 59-5107)

Remigius Algimantas Gaska, Ph.D.
The Pennsylvania State University, 1959

The major objectives of this work were the studies of vapor and liquid flow in packed and plate fractionation towers and the development of new-type of vapor-liquid contactors.

Packed distillation columns are very attractive for laboratory use and prove to be highly efficient, but many lose much of their efficiency when diameter and height are increased. A further insight was sought to the problem of channeling and various ways and means were investigated in trying to eliminate this bad effect.

Conventional packed distillation columns were divided into annular spaces by installing concentric tubes in the packed bed. Further division was achieved by subdividing the annular spaces into sections. Each section was equipped with a separate cold finger condenser permitting the return of condensed vapor to the same section. The columns were operated at atmospheric pressure and total reflux. The packing used was 0.24x0.24-inch protruded packing. Operating a 6-inch I.D. column with a 2-inch concentric tube in its packed bed and using the test mixture of benzene-toluene the H.E.T.P. values were reduced from 4.3 to 3.5 inches when compared to a conventional packed column. Further lowering in H.E.T.P. values was observed when the annular space was subdivided into five sections. H.E.T.P. values of 3.1 inches were recorded. Similar work with the 12-inch I.D. column using the test mixture of n-heptane-methylcyclohexane did not show any improvement in H.E.T.P.'s. It is thought that by subdividing the column into sections sharp corners were introduced and it is likely that channeling existed at these corners.

The other part of this work was devoted to the design, construction and testing of new-type vapor-liquid contactors. These contactors were tested in a 6-inch I.D. column with and without Controlled Cycling. Controlled Cycling is a principle which can be used in distillation, extraction, particle size separation and other operations. When used in distillation the cycle consists of two parts: the vapor and the liquid flow periods. During the vapor flow period vapor is rising through the column and there is practically no liquid flowing down the column; during the liquid flow period the opposite is true: there is no vapor moving up the column. The vapor flow, and in turn the liquid flow, is controlled by a solenoid valve installed in the vapor feed line. The duration of vapor and liquid flow periods can be varied independently.

A contactor, called the Packed-Plate Contactor, was developed and tested. It consisted of a 2-inch high cylinder filled with 0.24x0.24-inch protruded packing. Its top and bottom were covered with screen. The performance of this contactor was good, particularly when operated with Controlled Cycling. At a superficial vapor velocity of 1.9 ft./sec. and a contactor spacing of 8 inches its efficiency was 106%. The pressure drop over a contactor was 2.3 mm Hg. The maximum recorded efficiency of this contactor was 110%.

The distribution of the liquid phase in a packed bed

was studied employing a 4-foot high 12-inch I.D. column packed with protruded packing and using water and air as the test system. The studies disclosed the tendency of the liquid phase to accumulate in the wall sections at the bottom of the tower and its inclination to follow established flow-paths even after its point of introduction had been changed.

In addition, a few minor projects were performed. They consisted of: the application of Controlled Cycling to packed columns, employment of constant flooding at top of a packed tower, installation of cold finger condensers throughout the length of a packed bed, and development of a screen plate and its testing with and without Controlled Cycling. Microfilm $2.35; Xerox $8.20. 180 pages.

INVESTIGATION OF STRUCTURE IN LEAD BORATE GLASSES.

(L. C. Card No. Mic 59-4516)

Robert Leif Hallse, Ph.D.
University of Illinois, 1959

Five lead borate glasses ranging in composition from 25 to 65 mol % PbO, with the remainder being B_2O_3, were studied in order to determine their structure. The investigation was carried out in two parts, namely, (1) correlation of experimental and calculated X-ray intensity curves and (2) determination of various physical properties of the glasses.

The X-ray work consisted of obtaining X-ray diffraction patterns of the glasses using an X-ray diffraction powder camera, converting these patterns to X-ray intensity curves by means of a microphotometer, and finally plotting X-ray intensity versus $\sin\theta/\lambda$. The samples used in the X-ray camera were thin films of glass which were fragments of bubbles which had been blown from the glasses. X-ray exposure times were one-half hour using a copper tube operated at 15 milliamps and 40 kilovolts.

These experimental intensity curves were then compared with curves obtained by first assuming a structure for the glass and then calculating the X-ray intensity at various values of θ that would result from the assumed structure. This was done using an equation having the form:

$$I = \Sigma_m \Sigma_n f_m f_n \frac{\sin sr_{mn}}{sr_{mn}}$$

where $f_m f_n$ = atomic scattering factors for m and n atoms, respectively

$$s = \frac{4\pi \sin\theta}{\lambda}$$

r_{mn} = distance between m and n atoms

The assumed structure was modified until good agreement resulted between the experimental and calculated intensity curves. It was concluded from the X-ray evidence that lead borate glasses in the composition range studied consist of a random network of BO_4 tetrahedra, with lead atoms having a coordination number of six occupying holes in the structure. Short range order was thought to exist with definite interatomic distances extending to 6.7 A, this being the distance between two lead atoms.

It was thought that if such a random network did exist a plot of any physical properties versus the percentage of one component in the glass would result in smooth curves, and that any maxima or minima in the curves would indicate a change in the coordination number of the boron or lead atoms, or the formation of a compound.

The properties determined were coefficient of thermal expansion, softening temperature, transition temperature, index of refraction and volatility. Density and surface tension data obtained by other investigators were also studied. All properties except volatility, surface tension and composition of the volatilized vapor indicated a random network structure. The surface tension and lead content of the volatilized vapor both reached their maximum values around 82% PbO and the volatility curve had a minimum in this same region. Since the surface tension data were obtained at 900° C. and the volatility data obtained at 1100° C. it was concluded that at elevated temperatures the compound 5 $PbO \cdot 4B_2O_3$ tends to form.

Microfilm $2.00; Xerox $3.00. 57 pages.

THE EFFECT OF NUCLEAR RADIATIONS ON BENZENE-WATER SYSTEMS.

(L. C. Card No. Mic 59-4933)

Terry Robert Johnson, Ph.D.
University of Michigan, 1959

The purpose of this investigation was to study the effect of gamma photons and neutrons on benzene-water systems. Water solutions saturated with benzene were irradiated in the cobalt-60 source and the Ford Nuclear Reactor which are located in the Phoenix Memorial Laboratory on the North Campus of the University of Michigan. Cadmium sulfate, boric acid, and lithium metaborate were added to the benzene-water solution in order to increase the energy absorbed in the solution due to the thermal neutrons. Phenol was the principal product in all cases. The radiation yield of phenol in each solution in cobalt-60 radiation was compared to the yield in the mixed radiation from the nuclear reactor.

A photometric analysis for phenol was adapted to each of the experimental systems. The analysis depended on the wave length shift of the ultraviolet absorption peak of phenol from neutral to basic solutions. The total gamma dose was determined with the standard ferrous sulfate dosimeter in both the cobalt-60 and reactor radiation. A radiation yield value for ferric ions of 15.4 micromols per liter per kilorep was used. The thermal neutron flux was calculated from an empirical correlation of gamma and neutron fluxes.

The yield of phenol in irradiated pure aerated water saturated with benzene was 2.06 micromols per liter per kilorep. The phenol yield was equal to the reported yield of hydroxyl radicals in irradiated water indicating that benzene is a specific scavenger for hydroxyl radicals. The yield of phenol depended only on the total gamma dose. For samples irradiated near the nuclear reactor, no effect of the neutron flux within the samples could be detected. The phenol yield decreased in oxygen depleted

solutions and in solutions in which the benzene concentration was below 0.007 M. Phenyl peroxide and diphenyl were important by-products of the radiation induced reaction. Reaction mechanisms for the formation of phenol are developed and discussed.

Cadmium sulfate and boric acid had a small, explainable effect on the phenol yield from gamma radiation. Lithium metaborate had a large, but unexplained effect. The radiation yields of phenol in the three systems were: cadmium sulfate -- 2.08; boric acid -- 2.30; lithium metaborate -- 1.67 micromols per liter per kilorep. Reactor irradiations of these systems showed that the neutron capture energy resulting from neutron capture within the experimental solution had no detectable effect on the phenol yield.

The benzene-pure water system proved to be an excellent dosimeter for gamma energy. It has several important advantages over the ferrous dosimeter. Benzene-water is as accurate as the Fricke dosimeter but is more reliable and adaptable.

Microfilm $2.55; Xerox $8.80. 193 pages.

DIFFUSION FROM A SOURCE OF MASS FOR TURBULENT FLOW OF WATER AND OF SLURRIES IN A PIPE.

(L. C. Card No. Mic 59-4523)

Hisao Kada, Ph.D.
University of Illinois, 1959

Measurements of point source turbulent diffusion were made for flows of water and of water slurries containing fine glass or copper spheres. The volumetric concentration of the spheres ranged from 0.5 to 2.5 percent and Reynolds numbers used were 20,300 and 50,550. A 1N solution of KCL was injected into the flow as diffusing material. From the concentration profiles the mean square displacement of KCL from the center of a profile, $\overline{Y^2}$, was calculated. By plotting the values of $\overline{Y^2}$ versus diffusion time t, eddy diffusivity $E = \overline{v^2}\tau$ and Lagrangian time scale of turbulence τ were obtained. The intensity of turbulence $\sqrt{\overline{v^2}}/U_c$ was calculated from E and τ for three forms of the correlation coefficient for water flows.

The results of the investigation for mass diffusion in water indicated that the concentration profiles in this study were all Gaussian and the dimensionless eddy diffusivity $\overline{v^2}\tau/DU_c$ versus Reynolds number data agreed with the data obtained by Flint and the former data by the author but disagreed with the data by Towle and Sherwood. The intensity of turbulence $\sqrt{\overline{v^2}}/U_c$ versus Reynolds number data showed somewhat larger values of $\sqrt{\overline{v^2}}/U_c$ than Flint's measurements and much larger values than Sandborn's hot wire measurements. The reasons for these discrepancies were examined.

For the measurements in slurries, the concentration profiles were usually not Gaussian at small diffusion times when the presence of solid particles caused change in concentration profiles. The effect of solid particles on the characteristics of turbulence depended on factors such as the diameter of solid particles D_p, the volumetric percent of the solid C, the difference of densities between the solid particles and water $\rho_p - \rho_f$, and Reynolds number of the flow. Theories were suggested to explain the effect of the presence of solid particles on the characteristics of turbulence. The relative velocity of solid particles to the bulk fluid was considered to cause an energy input into the turbulent flow resulting in a change of the properties of the turbulence. The displacement of fluid elements due to the random motion of solid particles seemed to contribute to the increase of eddy diffusivity. The effect of the turbulent fluctuation on the slip velocity of the solid particles was calculated.

Microfilm $2.00; Xerox $6.20. 127 pages.

THERMAL CONDUCTIVITY OF BUTANE AT HIGH PRESSURE.

(L. C. Card No. Mic 59-4159)

Francis Ronald Kramer, Ph.D.
Purdue University, 1959

Major Professor: E. W. Comings

A concentric cylinder thermal conductivity cell has been developed for high pressure and the thermal conductivity of butane has been measured in the gas and liquid states near the critical and in the single phase region well above the critical pressure.

The cell fits into the cavity of a high pressure vessel, which is submerged in a constant temperature oil bath. A platinum wire is wound around a milled, spiral groove in a supramica inner cylinder; the wire serves both as a heat source and resistance thermometer. The supramica cylinder fits into an intermediate copper cylinder, which in turn fits into a hole in an outer copper cylinder with a radial clearance of 0.006". Heat flows radially from the platinum wire, in series, through the intermediate copper cylinder, the 0.006" gas gap, the outer copper cylinder, and then through an all metal path to the oil bath. By means of a thermocouple placed in the outer copper cylinder, and the platinum resistance wire, the temperature difference, Δt, from inner to outer cylinders is established, and the heat, Q, generated in the wire, is measured. Analysis of heat flow in the cell indicates that $\frac{\Delta t}{Q}$ is a function of $\frac{1}{k}$, the reciprocal thermal conductivity of the gas in the cell. The cell is calibrated at one atmosphere with gases of known thermal conductivity. The quantity $\frac{\Delta t}{Q}$ is then measured for the gas of unknown conductivity, and $\frac{1}{k}$ is established from the calibration curve. Radiation and convection are minimized by the thinness of the gas layer and by the use of small temperature differences, of the order of $3^\circ F$.

The thermal conductivity of butane was measured along isotherms at $167^\circ F$ ($T_R = .819$), $222^\circ F$ ($T_R = .889$), $285.5^\circ F$ ($T_R = .971$), and at $327^\circ F$ ($T_R = 1.03$). Measurements at $T_R = .819$ and .889 were conducted at

pressures ranging from one atmosphere to over 1,000 atmospheres (28 times the critical pressure). These isotherms showed smoothly rising values of thermal conductivity in the gas phases, and in the liquid phases removed from the bubble point; near the bubble point, small humps appeared in the liquid phase. Measurements along the 285.5°F isotherm to a pressure 22 times the critical showed smoothly rising values in both phases, but exhibited a large rise in the liquid phase near the two-phase region. These irregularities were interpreted as being due to an instability in the liquid phase in the vicinity of the two-phase region. Calculations of molecular volumes in this region and at higher pressures indicate a change in molecular array. The isotherm at $T_R = 1.03$ had a high peak slightly past the critical pressure. This was demonstrated to be due to convection.

Over a limited range of densities the thermal conductivity of liquid butane is found to vary with density to the 2.2 power.

A single curve, independent of temperature and pressure, correlates both gas and liquid data on a residual thermal conductivity-density chart. This chart permits evaluation of the thermal conductivity of butane at any combination of temperature and pressure giving a density between .3 and 40 lbs/cu.ft. Propane data from the literature was correlated by a similar plot, allowing evaluation of thermal conductivity values at any combination of temperature and pressure giving a density between 1.0 and 32 lbs/cu.ft.

At $T_R = 1.03$ the thermal conductivity ratios of butane and propane at $P_r = 5$ correspond to within 8 per cent. At the same reduced conditions, butane deviates from the Lenoir, Junk and Comings correlation by 63 per cent. A correlation based on a semi-theoretical development is proposed, where thermal conductivity ratio for substances within a given class is taken as a function of reduced temperature, reduced pressure, and C_p^*, heat capacity at one atmosphere. Data on a few lower hydrocarbons roughly support this correlation, as do data on nitrogen and oxygen. A more general, empirical correlation is also proposed, giving thermal conductivity ratio of all classes of substances as a function of reduced temperature, reduced pressure, and k_c/k_c^*, the ratio of critical thermal conductivity to thermal conductivity at one atmosphere and the critical temperature. Data on various gases at $T_R = 1.03$ support this correlation.

One atmosphere thermal conductivity data for several lower hydrocarbons are plotted as the ratio of thermal conductivity, k*, to thermal conductivity at the critical temperature, k_c^*, versus reduced temperature. For the substances tested, a single straight line results.

Microfilm $2.15; Xerox $7.60. 161 pages.

TWO-PHASE COCURRENT FLOW IN PACKED BEDS.

(L. C. Card No. Mic 59-4945)

Robert Pruett Larkins, Ph.D.
University of Michigan, 1959

Two-phase cocurrent flow of gas and liquid through packed beds was investigated experimentally to determine a correlation suitable for the prediction of the pressure drop accompanying two-phase downward flow. The fraction of the void volume occupied by liquid, termed the liquid saturation, was also investigated since the density of the flowing mixture represents a contribution to the total frictional energy loss in vertical flow. An important application of the correlations for liquid saturation and pressure drop is in the design of trickle bed reactors of the type used to react hydrogen gas and lube oil at high temperature and pressure during cocurrent downward flow over a catalyst bed.

Experiments were carried out with air and several liquids on several packing materials contained in a 4-inch column. The liquid viscosity was varied with water, water solutions of methylcellulose, and ethylene glycol, and the packing properties were varied with 3/8-inch Raschig rings, 3/8-inch spheres, and 1/8-inch cylinders. Measurements of pressure drop and liquid saturation were obtained over the entire range from 100 per cent liquid to 100 per cent air. The liquid saturation was measured by trapping the flowing fluids between two quick-closing valves at the ends of the eight foot test section. A wide range of flow rates were investigated and pressure drops as high as 14 psi per foot were obtained at the maximum rates. Two distinct flow patterns were observed. A uniform pattern throughout the packed bed was termed the "homogeneous mode" of flow, and an unstable pattern which was made up of alternate segments of lower and higher density was termed the "slugging mode" of flow.

A single correlation which is valid for both modes of flow was established over the range of the experimental variables. The pressure drop data are correlated in terms of χ which is defined as the square root of the ratio of the pressure drop for horizontal single-phase flow of the liquid, δ_l, to the pressure drop for horizontal single-phase flow of the gas, δ_g. The single-phase pressure drops is psi per foot for horizontal flow express the total frictional loss for each of the fluids flowing alone in the vertical bed. The two-phase frictional loss is expressed by

$$\log_{10}\left(\frac{\delta_{lg}}{\delta_l + \delta_g}\right) = \frac{0.416}{(\log_{10}\chi)^2 + 0.666},$$

where δ_{lg} is the two-phase frictional loss and is related to the two-phase pressure drop by

$$\delta_{lg} = -\left(\frac{\Delta P}{\Delta L}\right)_{lg} + \rho_m,$$

where ρ_m is the density of the flowing mixture in psi per foot. For horizontal flow, δ_{lg} is equal to the absolute value of the pressure drop. The density of the flowing mixture is a function of the liquid saturation, R_l, which was found to be a function of χ alone and can be expressed by

$$\log_{10} R_l = -0.744 + 0.525(\log_{10}\chi) - 0.109(\log_{10}\chi)^2.$$

Data taken on foaming systems resulted in pressure drops as much as six times those for the corresponding non-foaming conditions. The effect decreases with increased rates or packing diameters. A considerable number of unpublished data on hydrocarbon systems supported the correlation for non-foaming systems and confirmed the deviations observed for foaming systems.

The pressure drop correlation is expected to apply to the horizontal and upward flow cases, with the suitable

density correction, and the dimensionless form of the final correlation facilitates extrapolation. Agreement with correlations for two-phase flow in pipes supports the wide extrapolation of porosities.

Microfilm $2.20; Xerox $7.80. 168 pages.

INVESTIGATION OF A HORIZONTAL FRACTIONATING DEVICE.

(L. C. Card No. Mic 59-4079)

Michael Markels, Jr., Eng.Sc.D.
Columbia University, 1957

A horizontal fractionator has been proposed in which the vapor flows horizontally and the liquid, flowing generally countercurrent to the vapor, is pumped over a series of cross-flow stages. This column design should find application where a multi-staged fractionator is needed which has high capacity and low pressure drop in large sizes. The experimental portion of this investigation is concerned with the design and testing of suitable stages for this fractionator. These stages are a special case of a cross-flow contactor in which no back mixing occurs in either phase, and the contact takes place without liquid seal. A dimensionless group, Z, is proposed which is the ratio of the dynamic head of the vapor entering the stage to the stage pressure drop.

$$Z = \left(\frac{V^2\rho}{2gc}\right) / \Delta P \qquad \text{IV-1}$$

This group measures the mechanical efficiency of the stage and is used to compare the designs investigated with literature values for bubble cap and sieve plates.

The stage designs tested included four porous bats each measuring 16 x 25 x 4 inches with the 25 inch side in the direction of liquid flow. Pressure drop and entrainment studies were first made on each bat using an air-water system. Bat No. 1, a heavy, close knitted bat made of stainless steel wire showed relatively high pressure drop and moderate entrainment. The pressure balance was important in keeping the water in the bat. Bat No. 2 was made like No. 1, but of lighter, more open weave. It gave good pressure drop and entrainment results, but had a narrow operating range because of the pressure balance requirements. Bat No. 3 was made of expanded aluminum mesh and had poor operating properties. Bat No. 4 was made of wire screen bent into a cellular structure. This bat had slightly higher pressure drop than No. 2, but tended to hold the water within the bat.

Bats No. 2 and 4 were used for mass transfer runs. In these runs the resistance to mass transfer in each phase was measured separately, by humidification for the vapor phase and by oxygen desorption from water by air for the liquid phase. For these two bats the individual phase contacting efficiencies were as good or better than those reported for bubble cap and sieve plates in the literature, but the values of the Z ratio were an order of magnitude higher.

These results indicate that a commercial horizontal fractionator is feasible and deserves further investigation. They also show that a cross-flow contactor can be built which has the contacting efficiency of bubble and sieve plates without the liquid seal and high pressure drop and which will operate effectively in large sizes and high liquid and vapor loads.

Microfilm $5.20; Xerox $18.40. 407 pages.

NON-IDEAL STAGE MULTICOMPONENT ABSORBER CALCULATIONS BY AUTOMATIC DIGITAL COMPUTER.

(L. C. Card No. Mic 59-4973)

Arthur Eugene Ravicz, Ph.D.
University of Michigan, 1959

The purpose of the investigation was fourfold: (1) to formulate a mathematical model of an actual or non-ideal vapor-liquid contact device, such as a bubble-cap plate, and to make this model suitable for use with an automatic computer; (2) to develop a computer procedure for predicting the mass transfer relations involved in the non-ideal stage; (3) to investigate the use of enthalpy, equilibrium, and physical property correlations more rigorous and accurate than those currently in use; and (4) to demonstrate the soundness and applicability of the non-ideal stage approach by writing a computer program for its use and comparing predicted performance of actual equipment with test data.

The equipment selected for investigation was the multicomponent petroleum gas absorber. Computation was done on the IBM 704 electronic data processing machine installed at the General Motors Technical Center, Detroit, Michigan.

Mass transfer relationships for the non-ideal stage were developed. These equations made use of the Murphree vapor plate efficiency concept in a manner slightly different from the original definition. (The efficiencies, developed for distillation columns operating with constant vapor and liquid flow rates, were found to be unsuitable for absorbers when used as originally defined.) A heat transfer expression, similar in form to the mass transfer equations, was used for computing vapor temperatures. The Colburn mass transfer-heat transfer analogy was employed to estimate heat transfer efficiencies based on the Murphree plate efficiencies. K values (vapor-liquid equilibrium ratios) at a given operating pressure were correlated as functions of temperature and convergence pressure (an index of the liquid phase composition). Vapor and liquid enthalpies were evaluated by thermodynamically-consistent step-wise procedures with consideration given to the effects of pressure and composition. A digital computer program was written for predicting the performance of petroleum gas absorbers. The plate-to-plate computation upward through the column, originally quite unstable, was made convergent by a correction technique based on relative, rather than absolute errors. The resulting slowly-convergent sequence was speeded up by an application of the Wegstein extrapolation method.

Four actual operating absorbers (at pressures from 232 psia to 1475 psia) were analyzed, the computed results being compared to the test data. Generally good agreement was found; the greatest discrepancies occurred between computed and test values of recovery

of medium-volatility components and liquid temperatures in the upper parts of the columns. The effects of intercooling and of stripping of the lean oil to an absorber were investigated. The degree to which the non-ideal stage calculation would approach an ideal stage procedure was determined by making a calculation using heat and mass transfer efficiencies of 1.00.

It appears that the non-ideal stage calculation is a very useful tool for those seeking better ways of understanding, analyzing, and predicting the operating conditions of vapor-liquid stage contacting devices. The mass transfer and heat transfer relationships employed by the computer program are suitable, but the methods of estimating the efficiencies involved require improvement. The interaction of mass transfer and heat transfer, usually neglected in this type of calculation in the past, must ultimately be understood.

Microfilm $3.25; Xerox $11.20. 251 pages.

GAS CHROMATOGRAPHY AS A RECOVERY PROCESS.

(L. C. Card No. Mic 59-4979)

Robin James Robinson, Ph.D.
University of Michigan, 1959

A study has been conducted to determine the important variables in the design of a chromatographic column for use in recovery processes. Correlations are presented giving the effects of temperature and column length on retention volume, and the effects of flow rate, sample size, and column length on band width for systems of isobutane and normal butane.

Resolution in a separation, the gap between two sucessive peaks, is defined in terms of retention volume and band width:

$$R = (V_{R_2} - V_{R_1}) - 1/2(W_1' + W_2') .$$

High resolution (i.e. high degree of separation) results from chromatograms with narrow peaks and widely differing retention volumes. The effects of temperature and column length on retention volume have been studied for isobutane and normal butane systems. The data show that retention volume is directly proportional to column length over the range considered. This result is in agreement with the theoretical model used.

Retention volume is theoretically related to temperature by an expression of the form:

$$\log \left[\frac{V_R - V_V}{T}\right] = c'/T - c'' ,$$

where c' and c" are constants, and V_V is the void space in the column. The data for the systems studied satisfactorily fit this form. An expression of the form:

$$\log V_R = k_1/T + k_2 ,$$

where k_1 and k_2 are constants, also fits the data. As the operating temperature decreases, the retention volumes of iso and normal butane increase and also diverge from one another.

The effects of flow rate, sample size, and column length on band width are also presented. In agreement with theory, band width is proportional to the square root of the column length. This fact is used to incorporate data taken on columns of varying lengths into a single correlation of band width and flow rate.

From the van Deemter equation for Height Equivalent to a Theoretical Plate, an expression may be derived relating band width to average volumetric flow rate in the form:

$$W = J\left[\frac{A}{\bar{v}^2} + \frac{B}{\bar{v}^3} + \frac{C}{\bar{v}}\right] ,$$

where J, A, B, and C are constants. The data for the systems studied are successfully fitted by correlations of this type. From these expressions, it is clear that band width is a decreasing function of flow rate or velocity. Three sources of band broadening are "eddy" diffusion, molecular diffusion, and resistance to mass transfer. At higher flow rates the resistance to mass transfer between the liquid and gas phases is shown to be the main source of band broadening.

The correlations representing the effect of sample size on band width agree in general shape with the theoretical curves calculated from the mathematical model. However, the two differ in magnitude. Possible explanations for the discrepancy have been offered. The most likely seems to be that the method of sample injection was not adequately represented by the model used.

It is felt that the general agreement of the results with the theoretical model makes it possible for the results obtained on the systems studied, normal and isobutane, to be extended to other systems with a minimum of experimental work.

Microfilm $2.10; Xerox $7.40. 157 pages.

INTERFACIAL TENSION OF SYNTHETIC CONDENSATE SYSTEMS.

(L. C. Card No. Mic 59-4747)

George Leo Stegemeier, Ph.D.
The University of Texas, 1959

Supervisor: Dr. E. W. Hough

Surface and interfacial tension of several light paraffin hydrocarbons were determined experimentally at elevated temperatures and pressures by the pendant drop method. Particular emphasis was placed upon the investigation in the neighborhood of the critical points. As the critical points were approached, interfacial tension as low as 0.007 dynes/cm was measured.

The surface tension of liquid propane against its vapor was determined from 95°F to 202°F, and the surface tension of liquid normal butane against its vapor was measured from 86.5°F to 291.7°F. The two component system, methane--n-pentane, was studied at the 100°, 150°, 160°, 170°, 190°, and 200°F isotherms from pressures of about 500 psia to the critical pressures over 2000 psia. A second two component system, methane--n-decane, was studied at the 100°, 130°, 160°, and 190°F isotherms from pressures of about 1500 psia to the critical pressure at more than 5000 psia.

The data from the two single component systems were compared to the reduced temperature correlations of Guggenheim and were found to be very nearly coincident with the equations:

$$\gamma = \gamma_0 (1-T/T_c)^{11/9}$$

$$\gamma/\Delta\rho = C' (1-T/T_c)^{8/9}$$

$$\Delta\rho = C (1-T/T_c)^{1/3}$$

From these observations it is believed that the parachor relation of surface tension to density difference is expressed by the equation:

$$\gamma = C''(\Delta\rho)^{11/3}$$

The exponent 11/3 in this equation results in a better fit with the experimental data than the exponent of 4 given by Macleod. Using experimental surface tension and density difference data with the equation above, a new set of parachor numbers was calculated for the normal paraffin hydrocarbons. These parachor numbers were used in Katz's correlation for two component systems. This correlation involves a prediction of interfacial tension from parachor and PVT data. Interfacial tension throughout the complete two phase region, including the parts for which no PVT data are available, was predicted from the experimental determinations of this work and from the surface tensions of the pure components. The interfacial tension in the high pressure part of the two-phase region appears to remain small at sizeable pressures below the critical pressure. For example, in the case of the methane--n-decane system, on the 100°F isotherm, the interfacial tension remains less than one dyne/cm for a pressure drop of more than 1000 psi below the critical pressure at 5310 psia. This behavior is paralleled on the other isotherms and suggests that interfacial forces are extremely low throughout the high pressure part of the two-phase region. The methane--n-pentane system showed a similar behavior in the high pressure region if the data are considered on a reduced pressure basis.

Correlations of surface tension with enthalpy change of vaporization at constant pressure did not appear to hold in the vicinity of the critical point; however, it must be noted that this enthalpy change of vaporization undergoes an extremely rapid change in the region near the critical making experimental determinations difficult. Experimental values of enthalpy change of vaporization were taken from Sage & Lacey.

Excess of methane in the surface, assuming the heavier component excess to be zero, was calculated for both two component systems. Maximum values for the surface excess of methane at 100°F were 2.1×10^{14} molecules/cm^2 for the methane-normal pentane system and 2.5×10^{14} molecules/cm^2 for the methane-normal decane system. The similarities of these maximum values for two systems having widely different compositions suggests the possibility of surface excess as a correlating device.

Two aids for pendant drop calculations were developed in the course of this work. The first is an I.B.M. 650 computer program for the pendant drop calculation. This procedure is utilized when large numbers of drop measurements must be calculated accurately. The second aid in pendant drop calculations is an approximate equation which allows slide rule calculations of surface tension directly from measured data, thereby obviating the use of a table for the determination of 1/H. The equation is accurate to within 0.5%.

Symbols

γ	- interfacial tension
$\Delta\rho$	- density difference
T	- temperature
T_c	- critical temperature
γ_0, C, C', C''	- constants

Microfilm $3.50; Xerox $11.80. 269 pages.

THE EFFECT OF PRESSURE ON THE STRUCTURE OF CERTAIN ELEMENTS AND MOLECULAR AND FERROELECTRIC COMPOUNDS.

(L. C. Card No. Mic 59-4575)

Harold Laverne Suchan, Ph.D.
University of Illinois, 1959

The explanation of many physical phenomena such as electrical conductivity and ferroelectricity in solids can be obtained from a knowledge of the energy distribution of the electrons within the solid. The use of quantum mechanics to develop adequate theories consistent with spectroscopic and electrical experiments has greatly aided our comprehension of solid state phenomena. This research dealt with the determination of the optical absorption spectra of some ferroelectrics, elements and molecular compounds while they were subjected to high pressure using special equipment previously developed in this laboratory. This equipment can be used for the spectroscopic studies of a solid at pressures exceeding 200,000 atmospheres.

The substances which were studied include the ferroelectrics, barium titanate and triglycine sulfate; the elements, red phosphorus, selenium, arsenic, and iodine; and the molecular compounds, mercurous chloride, mercurous bromide, mercurous iodide, stannic bromide, stannic iodide, carbon tetrabromide, carbon tetraiodide, and iodoform. In each substance except triglycine sulfate the shift in the fundamental absorption edge with pressure was determined. The data are presented and show the shift in the absorption edge with pressure, the atmospheric edge from which the shift was measured, and the approximate absorption coefficient. In triglycine sulfate two phase transitions at 23,000 atmospheres and 39,000 atmospheres were detected and found to be independent of temperature in the range from 25° C to 60° C.

Certain general conclusions from the results of the work were discussed on the basis of the energy band theory. The small red shift of the absorption edge of barium titanate when compared with the blue shift of titanium dioxide (rutile) was apparently dependent upon the crystal lattice symmetry. All the elements had a large red shift of the absorption edge with pressure. This shift depended primarily on the relative compression of the elements and a metallic state would be reached at

pressures below 300,000 atmospheres. The molecular compounds displayed a large red shift of the absorption edge with pressure which was strongly dependent on the halogen for the same crystal symmetry. The relative shifts for the iodides could not be described in terms of compression alone but the metallic state would be reached for most molecular compounds at a pressure of about 300,000 atmospheres.

Microfilm $2.00; Xerox $5.00. 99 pages.

INVESTIGATION OF RARE EARTH DOPED BARIUM TITANATE.

(L. C. Card No. Mic 59-4576)

Victor Joseph Tennery, Ph.D.
University of Illinois, 1959

The possibility of doping an insulator with impurity ions of the proper ionic size, valence, and number and thereby producing a semiconducting solid has been known for some time. In this investigation the effect upon the D.C. resistivity of barium titanate of additions of from 0.0015 to 0.0030 mole fraction of rare earth oxide was investigated. The substitution may be represented by $(X_2O_3)_M(BaTiO_3)_{1-M}$ where X is the rare earth. The rare earths samarium, gadolinium and holmium were introduced singly into the titanate and the resistivity examined as a function of temperature from -170° to +330° C.

Upon sintering, the titanate containing the added impurities became blue in color indicating that some of the Ti^{+4} ions in the lattice had been transformed to the +3 state. In order to obtain ohmic contacts for the resistivity measurements it was necessary to use a 50% Indium-50% Gallium alloy as the electrode metal. Measuring voltages of 0.10 volts and less were used to avoid internal heating of the solid.

The activation energies for conduction in the rhombohedral, orthorhombic and tetragonal phases were low. In the rhombohedral and orthorhombic phases the activation energies were of the order of 0.2 eV. while that in the tetragonal phase was approximately 0.1 eV. With increasing impurity concentration the resistivity at 25°C. was observed to decrease from 8×10^{10} ohm-cm. for the pure titanate to about 10^3 ohm-cm. and then increase again in samples containing the highest impurity concentration. In the case of samarium doping, the resistivity increased from 4×10^3 ohm-cm. to 4×10^7 ohm-cm. when the mole fraction of Sm_2O_3 was increased from 0.0020 to 0.0030.

At the ferroelectric Curie temperature 120°C., the resistivity of the doped titanate exhibited an anomalous rise which in some cases amounted to an increase in resistivity of 4000 times the value in the tetragonal phase. The magnitude of this increase was found to be greatest in those materials having the lowest resistivities in the tetragonal phase.

In those compositions containing 0.0015 and 0.0020 mole fraction of the rare earth oxide the tetragonal-cubic transition temperature remained essentially unchanged while the tetragonal-orthorhombic and orthorhombic-rhombohedral transition temperatures were depressed 4°C. In those compositions containing 0.0025 and 0.0030 mole fraction of the impurity oxide the Curie temperature was depressed to 115°C. and the two low temperature transitions were each decreased 16°C.

The log of the resistivity varied linearly with the reciprocal of the absolute temperature in the orthorhombic and rhombohedral phases, while some departure from linearity was observed in plots of data for the cubic phase.

The phenomenon of aging was observed in these materials, the resistivity increasing with time upon cooling through the Curie temperature. The ferroelectric state apparently exists in the semiconducting titanate, as polished sections of sintered samples revealed the domain structure characteristic of the ferroelectric material.

Thermoelectric probe measurements indicated that these materials were n-type in the tetragonal phase. Thermoelectric power measurements were made by the difference method on the pure titanate and a representative gadolinium doped sample as a function of temperature. At the tetragonal-cubic transition the semiconducting material changes from n-type to p-type. The sharp increase in resistivity is thus due to a decrease in the mobility of the electrons donated by the rare earth impurity to the titanium sub-lattice. A mechanism is proposed to explain this behavior, wherein the excess electrons become trapped on a particular titanium ion when the material becomes cubic. As a result the Ti^{+3} ions then act as acceptors and introduce holes in the band structure which act as the charge carriers in the cubic phase. No measurable thermoelectric power was observed in the pure titanate. The thermoelectric power of the doped material is approximately 700 $\mu V/°C.$ in the tetragonal phase.

Microfilm $2.00; Xerox $4.20. 77 pages.

ENGINEERING, CIVIL

STABILITY OF CELLULAR COFFERDAMS.

(L. C. Card No. Mic 59-4874)

Kamal Tawfiq Al-Chalabi, Ph.D.
University of Michigan, 1959

This investigation presents a general solution for the stability analysis and design of cellular cofferdams with definite considerations of the granular property of the soil and its stability according to the theory of arching; and the cohesive property of soil and its stability due to cohesion which is a result of the molecular attraction of the clay particles. Thus methods are set forth to investigate the various causes of failure which have been observed in the past. In addition special emphasis has been placed on the mass stability of the cofferdam, a problem frequently neglected in design of cofferdams. This problem is especially important when the cofferdam is to carry a large lateral thrust as is the case with the shore cofferdams used recently for ore yards.

As a theoretical background for this investigation, a brief historical review of cofferdams and a discussion of the previous solutions and their basic theories are presented. Then a resume of soil mechanics as developed

and adopted at the University of Michigan is given. Based on these concepts of soil mechanics formulas are derived for designing and analyzing cellular cofferdams filled with various types of fill and built on various types of foundations. Emphasis is placed on mass stability.

Based on these formulas and concepts an existing cellular cofferdam is analyzed. It was found to be critical with respect to mass movement of the underlying stratum. To test this cofferdam a lateral thrust was applied against it by loading an area behind the cofferdam. From the analysis it was concluded that a loaded area of 48.5 feet by 48.5 feet would be sufficient. The load capacity of the cofferdam was calculated for various overload ratios, (ratios of the stress imposed on the clay soil divided by the yield value as measured by laboratory test).

Certain field tests were then recommended to provide verification of the theoretical analysis. The field test was conducted by Inland Steel Company, Indiana Harbor, Indiana. The vertical displacement of monuments surrounding the test load area and at points on the cofferdam were measured to determine the effect of the loading. These measurements were made at various time intervals.

Observations and test data showed that there was no failure which could be indicated by a collapse. Although the cofferdam structure did not fail due to the applied loads, the mass of soil deformed allowing settlements to take place. These settlements indicate an overstressing of the underlying soft clay stratum. The allowable load for an overload ratio of one, as determined by the revised theoretical analysis, is 1700 pounds per square foot. The allowable load for an overload ratio of one (zero rate of settlement) determined from the test is 2040 pounds per square foot. This gives a good correlation between the theoretical and actual values.

Three general conclusions can be drawn. 1) The formulas derived for analyzing and designing cellular cofferdams, which were applied in the analysis of this cofferdam, are reliable. The result of the theoretical analysis in which these formulas are used showed a close correlation to that obtained from the test. 2) The mass stability of the underlying stratum is a critical factor in cofferdam design. Although the cofferdam itself is strong enough not to fail, the supporting earth mass may permit progressive displacement. Thus, in regard to this particular cofferdam, it is not recommended for the ore yard. 3) The introduction of the overload ratio, R, allows the designer to design the cofferdam for various rates of settlement. When the cofferdam is designed as a temporary structure, R may range between 2 to 2.5, or for a permanent structure, R may range between 1 to 1.5.

Microfilm $4.25; Xerox $14.40. 332 pages.

A DISTRIBUTION PROCEDURE FOR THE ANALYSIS OF CONTINUOUS RECTANGULAR PLATES.

(L. C. Card No. Mic 59-4484)

Alfredo Hua-Sing Ang, Ph.D.
University of Illinois, 1959

A method for the analysis of rectangular plates continuous in two directions over torsionally and flexurally stiff beams (stiffnesses ranging from 0 to ∞) and rigid columns is presented. The method is essentially an extension of the use of the calculus of finite differences with the aid of a physical model by which a plate is represented. The use of the model facilitates the fulfillment of the physical requirements of continuity and equilibrium between adjoining panels.

The solution of a continuous plate, in terms of the deflection of its middle plane, is divided into two parts: One part is due to the loading on the structure with arbitrarily prescribed boundary conditions for each panel; this part of the solution is obtained by direct application of finite differences. The other part is due to the boundary deformations of each panel which are required to satisfy continuity and equilibrium between adjoining panels.

The deflections of the interior points of a panel are related to the boundary deformations (edge rotation and edge deflection) of each edge joint, from which the deflections of all interior points can be determined once the boundary deformations of all the edge joints are found.

The boundary deformations are determined by a moment and reaction distribution procedure, the essential feature of which is based on Cross's moment distribution procedure for beams and frames. The distribution factors for a panel are determined by finite differences and take into account the effects of the beam stiffnesses and column dimensions.

The amount of numerical calculations involved in this method of analysis is so great that the solution of any problem of continuous plates is contingent on the availability of a high-speed digital computer.

Programs have been coded for the ILLIAC (the University of Illinois Digital Computer) in two parts. The first part calculates the boundary deformations of every panel in a given continuous structure with the initial zero boundary deformations and the corresponding fixed-edge moments and fixed-edge reactions of all panels given as data. The second part computes the deflections of all the interior points due to the boundary deformations and forms the total final deflections of the panels desired; this is done one panel at a time with the deflections due to the loading, and the boundary deformations of the corresponding panel as determined by the first part, given as data.

Three illustrative problems are given to show the applicability of the procedure. A typical interior square panel of a "flat plate" structure is presented to compare the results obtained by this method with those previously found by direct finite differences. This provides a check on the correctness of solutions obtained by this procedure. The results, in terms of the deflections and moments across certain sections of the plate, of two nine-panel "flat plate" structures with different strip loadings are presented in graphical form.

Microfilm $2.00; Xerox $5.80. 120 pages.

BEHAVIOR OF LARGE RIVETED AND BOLTED STRUCTURAL CONNECTIONS.

(L. C. Card No. Mic 59-4500)

Eugene Chesson, Jr., Ph.D.
University of Illinois, 1959

This thesis summarizes the results of thirty tests on full-size built-up members and provides information on the behavior at failure of several different types of connections commonly used in structural practice. Among the test variables included in the program were the specimen configuration, the method of hold preparation, and the size and type of fastener. A study is made of: the comparative behavior of the specimen types; the distribution of load to the gusset plates; the effect of hole preparation; the effectiveness of the webs of built-up I-sections; the effectiveness of the gusset plates; and the predicted and computed efficiencies of the connections.

A study has also been made of the computed and test efficiencies for a variety of specimens which were available in the literature as well as for the specimens tested in this program. On the basis of this analysis an expression has been prepared which may be used to predict the efficiencies of all forms of tension members. This expression is simple to apply and has an accuracy which is commensurate with the other factors affecting efficiency. Microfilm $2.45; Xerox $8.60. 186 pages.

A PROPOSED NAVIGABLE WATERWAY FOR THE WABASH AND MAUMEE RIVERS.

(L. C. Card No. Mic 59-4133)

Paul Day Cribbins, Ph.D.
Purdue University, 1959

Major Professor: Kenneth B. Woods

The construction of an inland waterway is a complex, expensive, and time-consuming procedure, the completion of which often necessitates the expenditure of hundreds of millions of dollars and the efforts of a large engineering force working for several years. Therefore, if such a vast project is needed, it is important that it be properly planned in order to determine its optimum location and design. To be worthwhile, it should provide the greatest benefits to the greatest number of people.

Used as a preliminary study, the purpose of this investigation was:

(1) to determine whether or not a navigable waterway between the Great Lakes and the Mississippi River system via the Wabash and Maumee Rivers is feasible;

(2) to determine the optimum location and design of the waterway from an engineering standpoint;

(3) to coordinate the various phases of the waterway into a multiple-purpose project;

(4) to estimate the average annual tonnages of various commodities that might move over the waterway during the life of the project;

(5) to ascertain the many other benefits which might accrue to such a project; and

(6) to calculate the benefit-cost ratio to find if the construction of the project would be economically justified.

An intensive inventory of existing conditions in the Wabash and Maumee Basins was the first step in the analysis. Information concerning the geological, climatological, and economic aspects of the two basins revealed the complexity and magnitude of the physical limitations of the area as well as many of the problems to be encountered during the actual construction. A recommended location for the waterway was determined by a pool-by-pool analysis of detailed profiles of the rivers, aerial photographs and topographic and geologic maps. Because of the great length of the waterway—544 miles—the project was divided into three nearly homogeneous sections for analysis purposes. The first section extended from the mouth of the Wabash River to Americus, Indiana (mile 324), within which the present river channel generally would be followed. The waterway left the river at this point and was canalized to a junction with the Maumee River near New Haven, Indiana (mile 451). The third section extended from New Haven to the mouth of the Maumee River at Toledo.

After the location was ascertained, an optimum waterway design was selected which would accommodate standard tows presently in use on the Mississippi and Ohio Rivers. A system of 29 locks and dams was devised to overcome the 567-foot total change in elevation between Lake Erie and the Ohio River and to provide slack-water pools for navigation. The specifications for the waterway included the following: minimum depth, 12 feet; bottom width, 250 feet; lock size, 84 by 600 feet; lifts, 10 to 40 feet; minimum radius of curvature, 1500 feet; minimum freeboard, seven feet; side slopes, one vertical to two horizontal; and vertical clearance, 27 feet.

The practical capacity of the proposed waterway was based upon the following set of conditions: a navigation season of 300 days per year, a standard tow capable of carrying 6,000 net tons, a relation of practical to theoretical operating capacity of 85 percent, and a lockage rate of 47, 50, and 54 lockages per day for 100, 50, and zero percent of back haul respectively. The calculated annual capacity of a 12-foot channel based on these conditions was between 48.6 million and 84.6 million tons per year, depending on the amount of back haul.

Water requirements for the Waterway totaled 1,562 cubic feet per second during the navigation season. To supply the difference between existing and required flows, a system of three retention reservoirs on streams was recommended. These would not only satisfy the water demand for navigation purposes but also provide considerable storage capacity for flood control on the upper reaches of the Wabash River.

Average annual damages from floods in the Wabash Basin alone are believed to exceed $5,000,000 per year. In order to reduce these damages and provide flood control for the Basin, a comprehensive system of reservoirs was recommended for various tributary streams. These included the Mississinewa, Salamonie, Huntington, Mansfield, Wildcat Creek, Pine Creek, Sugar Creek, and Monroe Reservoirs which could be constructed at an estimated cost of $87,475,000.

Other objectives of a multiple-purpose project such as power supply, domestic and industrial water supply, stream pollution abatement, irrigation, recreation, and fish and wildlife conservation were investigated and included in the project if feasible.

Cost estimates were prepared for all phases of construction and were based, whenever possible, upon

design and construction of a similar nature. Costs for the initial development of the Waterway totaled almost $800,000,000. This included costs for locks; dams; excavation; levees; bridge construction, reconstruction, and alterations; highway, railway, and utility relocation; land damages; reservoirs; channel regulation; and contingencies. For an assumed life of 50 years and an interest rate of 3.5 percent, the estimated annual charges were $38,560,707.

It was then necessary to evaluate the economic impact of the Waterway on the surrounding area. Several principal bulk commodities—namely, coal, grain, sand and gravel, vehicles and machinery, iron ore, sulphur, petroleum, cement, and fertilizer—were found to constitute a preponderance of the potential tonnage. Prospective savings were measured by computing the cost of transporting these commodities from sources to markets by barge via the Waterway less the cost of the least expensive alternative mode of transportation. To determine the true relationship of the annual benefits and costs of the project it was necessary to calculate the annual average benefits that would accrue over the life of the proposed project, estimated to be the period 1970 to 2019 inclusive. Potential tonnages were classified as local or through traffic and related to growth trends of appropriate indexes of the local and national economy. These projections indicated that the traffic during the mid-year of the project would total 54,168,000 tons and effect a savings of $157,980,000. This amount was credited to the Waterway as a navigation benefit. Benefits from other objectives increased this amount to $163,551,800.

The fate of any proposed waterway project depends on whether it is economically justified. To measure the economic worth of the project, a cost-benefit ratio was computed by which the annual costs were compared with the estimated annual benefits. A favorable economic ratio of 4.24 to 1 resulted, and construction of the project was recommended. Microfilm $4.50; Xerox $15.00. 349 pages.

AN ENGINEERING EVALUATION OF SURFICIAL SOILS IN NORTHEASTERN ILLINOIS.

(L. C. Card No. Mic 59-4510)

Thomas Samuel Fry, Ph.D.
University of Illinois, 1959

A study of the surficial soils in portions of Cook, Lake and DuPage Counties, Illinois has been made. This study summarizes soil test data, soils problems and experiences resulting from the design and construction of a major highway system in those three counties.

The study was conducted for the purpose of correlating the pedologic classification of soils with their engineering properties. These correlations were made to evaluate the possibility of making engineering soil studies in Illinois on a regional basis. At the present time highway designers often do not receive essential soils information in time to utilize it properly in the preparation of the completed plans. In many instances the highway is located both vertically and horizontally without proper consideration given to the soil conditions. Considerable economy can be realized in the design and construction of highways in Illinois if proper recognition of soil conditions is made during the early stages of design. Many construction problems can be alleviated or reduced by making proper use of soil studies during the preliminary phases of a project.

Soil association area maps have been used as the basis of this study. These maps are the result of recent investigations by agronomists. They delineate major soil units on the basis of the color of the surface soil and the texture and plasticity of the C or D horizons. Soil types within a soil association area are differentiated primarily on the basis of topography. This study consisted of compiling engineering test data, soil maps, design problems and construction problems characteristic of the major soil types found in each association area.

The results of this investigation show that it is feasible to make engineering evaluations on groups of soils in northeastern Illinois. The tests performed on the various soil types indicate that the engineering properties of the soils in each association area fall within a definite range. Thus, the soil association area concept of making regional soil studies can provide the basis for delineating locations where design and construction problems will occur. This research has revealed that soils problems which are an inherent characteristic of the soils in one association area are completely absent in others. This fact is of considerable value to the designers when making location studies. Many soil problems can be avoided by minor changes in line location if there is available a basis for predicting problem areas. Furthermore, a knowledge of these relationships should be of considerable value to prospective contractors for it would afford them the data they need to prepare more realistic bids without making borings and tests.

Microfilm $2.20; Xerox $7.80. 166 pages.

INELASTIC LATERAL-TORSIONAL BUCKLING OF ECCENTRICALLY LOADED WIDE-FLANGE COLUMNS.

(L. C. Card No. Mic 59-4293)

Theodore V. Galambos, Ph.D.
Lehigh University, 1959

Steel wide-flange columns which are subjected to an axial force and to end bending moments in the plane of their "strong" axis generally do not fail by bending in the plane of the applied moments if they are not adequately braced laterally. At a certain critical load these columns deflect in their "weak" direction. This is accompanied by twisting about the shear center. The phenomenon of lateral bending and twisting is known as "lateral-torsional" buckling.

Because of the presence of relatively high residual stresses in "as-rolled" wide-flange shapes, lateral-torsional buckling takes place when some portions of the column have already become inelastic for members in the practical length range. Whereas solutions are available for the computation of the elastic lateral-torsional buckling strength, no adequate methods have been developed for the computation of the inelastic case. A method whereby the inelastic lateral-torsional buckling strength

of "as-rolled" steel wide-flange columns may be determined is presented herein.

The following results are presented in the dissertation:

(1) Curves relating the coefficients of the lateral-torsional buckling equation and any combination of axial force and bending moment are computed for wide-flange shapes which are partially yielded.

(2) A method of computing "exact" interaction curves is presented, including the influence of an assumed, typical residual stress distribution.

(3) Interaction curves between the axial load, the end-bending moment, and the slenderness ratio are given for four representative wide-flange shapes (the 8WF31, the 14WF142, the 14WF246 and the 27WF94 shape).

(4) The influence of the cross-sectional size is investigated and a parameter is found which is primarily responsible for the variations in lateral-torsional buckling strength of wide-flange shapes.

(5) An approximate, simple method is presented for finding the lateral-torsional buckling strength of any column.

(6) Comparisons are made between the "exact" theory and currently used approximate methods.

(7) The results of this theory are checked by comparison with several sets of experimental data. It is shown that good correlation exists between theory and experiment.

The results of this research may be applied for the solution of the following practical problems:

(1) A lower bound for the lateral-torsional buckling strength of columns loaded by moments causing single curvature deformation may be obtained.

(2) Simplified and approximate methods may be checked for accuracy by comparison with the "exact" theory.

(3) The spacing for lateral bracing points, when lateral-torsional buckling must be prevented, can be determined.

Microfilm $2.85; Xerox $9.80. 219 pages.

EFFECTS OF HIGH TEMPERATURES ON THE PROPERTIES OF ASPHALT-AGGREGATE MIXES AND A NEW CONCEPT IN MIX DESIGN.

(L. C. Card No. Mic 59-5109)

William Henry Gotolski, Ph.D.
The Pennsylvania State University, 1959

The temperature effects on the stability characteristics of bituminous mixtures as measured by the Marshall method and the Hveem stabilometer were studied for four asphalt and aggregate temperatures. Temperatures to which the asphalt and aggregate were heated were 275°, 350°, 425°, and 500°F. This study was made to ascertain the lowest temperature at which detrimental characteristics are exhibited. Analysis of variance techniques were used to evaluate the basic factors affecting the test results and equations for the relationships observed were derived.

Test results from a "pure" shear test were combined with unconfined compression test results to arrive at a Mohr diagram to evaluate the angle of friction and the value of cohesion. These values were then compared with those of the triaxial compression test evaluation chart for asphaltic concrete to determine whether the mix was satisfactory or unsatisfactory. This suggests a new approach to evaluate the adequacy of a bituminous mixture prior to being placed in the field.

This study was limited to a laboratory controlled experiment using an 85/100 penetration grade asphalt. Two gradations of limestone aggregate were used and limited to surface course mixes at an asphalt content of six per cent by weight of the total weight of the mixture.

Brown, Sparks, and Larsen found that changes in softening points, penetrations, and ductilities of asphalts with time followed a simple hyperbolic law. By using this relation it is proposed that the temperature of aggregate during the mix process at a plant can be raised to 375° F. to produce satisfactory mixes for pavements.

For the aggregate gradations studied, the investigation has shown that the Marshall stability decreases as the asphalt pre-heat temperature increases, whereas the Hveem relative stability increases as the asphalt pre-heat temperature increases. The Marshall stability of both gradations increased as the aggregate temperature at the time of mixing and compaction increased, whereas this effect was not indicated for the Hveem relative stability.

It is believed that the concept using the Mohr diagram is a satisfactory procedure for measuring the stability of bituminous mixes, provided some modifications are made in the present equipment design. Also, it requires further investigation employing a greater range of aggregate types and sizes with various penetration grades of asphalt. Microfilm $2.65; Xerox $9.20. 202 pages.

A FIELD THEORY OF LAND USE AND THE MOVEMENT OF PEOPLE.

(L. C. Card No. Mic 59-4149)

Robert Theodore Howe, Ph.D.
Purdue University, 1959

Major Professor: Kenneth B. Woods

Varying types of land use induce the movement of people from place to place. A worker leaves his place of residence in the morning to go to a place of employment. On his way home in the late afternoon, he may stop at a shopping place. In the evening he may go with his family to a place of worship or of recreation, and will later return to his home. Highway engineers must know the basic patterns of such movements in a community inorder to plan new transportation facilities. To gain this knowledge in the past, they have made origin-destination surveys.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

This thesis develops a theory and investigates some techniques of synthesizing an origin-destination survey by assuming that each type of land use may be simulated by a center of positive electrical charge, while each human being may be represented by a unit, negative, electrical charge. Using these assumptions and the principles of electrostatic fields, three basic types of movements are developed in a simple hypothetical community. Two methods are used for solving one of these types of movement, trips between places of residence and places of employment; the first method being theoretically justifiable, while the second minimizes calculations. The validity of this theory is checked by predictions of work-trip patterns in Lafayette, Indiana, and the standard metropolitan area of Cincinnati, Ohio, and these predictions are compared with the findings of recent origin-destination surveys in the two cities.

The work-trip pattern for Cincinnati evolved from this theory appears to be as useable as that obtained from the comprehensive origin-destination survey. The field-theory approach also appears to be practical because: (1) all of the data needed is generally available in public documents; (2) with adequate zoning laws, the theory will permit the prediction of future travel patterns on the basis of assumed land uses, without any extrapolation from existing patterns; and (3) the entire work-trip pattern for Greater Cincinnati, involving about 200,000 interchanges between places of residence and places of employment, was developed with about 600 man-hours of work, including about 50 hours of calculation time on a high-speed digital computer.

Problems in adapting this theory to the prediction of other types of trips are discussed, and several suggestions are made for possible solutions.

Microfilm $2.25; Xerox $8.00. 172 pages.

STRESSES AND DISPLACEMENTS IN LAYERED SYSTEMS.

(L. C. Card No. Mic 59-4537)

Mahendrakumar Ratilal Mehta, Ph.D.
University of Illinois, 1959

The purpose of this investigation is to evaluate the stresses and displacements produced in a layered system under the influence of surface loads, and to determine the effects and the relative importance of the various factors that enter into the problem.

The system considered consists of an arbitrary number of linearly elastic, isotropic, homogeneous layers of finite thickness and of infinite extent in the horizontal direction. The lowermost layer is of infinite extent both in the horizontal and vertical directions. The thickness of each layer may be different and the physical properties of the material may vary from one layer to the next. A horizontal, continuous surface of contact is assumed between adjacent layers. These interfaces may be "rough" or "smooth".

This work included the following four phases: (a) the development of a numerical procedure that is well suited for use on a high speed digital computer, (b) the preparation of programs for the ILLIAC, the digital computer of the University of Illinois, (c) the application of these programs in the solution of layered systems for a range of parameters involved, and (d) the study, based on the numerical results obtained, of the influence of the various parameters.

The loadings considered produce either an axially symmetrical state of stress or a plane strain condition. The solution is obtained by first decomposing the loading into "components" by means of a Fourier transform. The stresses and the displacements for each component loading are then determined in terms of Love's stress function. The effects of the actual loading are found by superposing the effects of the component loadings. The interval of integration involved in this superposition is between zero and infinity. The resulting integrals are evaluated numerically by means of the Gauss quadrature method.

ILLIAC programs have been developed only for axially symmetric normal loads. The loads considered include a concentrated load and a load uniformly distributed over a circular area. It was found convenient to compute the effects along the axis of symmetry separately from those at points away from the axis. In their present form the programs are restricted to systems having a maximum of five layers. However, there are no restrictions placed on the values of the physical properties of the layers, and it is possible to consider any combination of rough and smooth interfaces.

Extensive numerical results have been obtained for systems with two and three layers for various values of area of loading, thickness, and relative stiffnesses of the layers. A few solutions have also been obtained for systems with four and five layers. These results show that the relative stiffness of the layers is a very important parameter.

With minor modifications, the present programs can be extended to plane strain problems and to problems involving surface shear forces.

Microfilm $2.00; Xerox $5.60. 115 pages.

AN EXPERIMENTAL STUDY OF THE STRESSES IN RING STIFFENERS IN LONG THIN-WALLED CYLINDERS SUBJECTED TO BENDING.

(L. C. Card No. Mic 59-4981)

Wadi Saliba Rumman, Ph.D.
University of Michigan, 1959

This dissertation presents and illustrates methods for computing the stresses in ring stiffeners in long thin-walled cylinders subjected to bending. Both the pure bending of the cylinder and the bending caused by transverse local loading are considered.

The study includes both an analytical and an experimental investigation. The analytical investigation which is based on solutions of analogous problems is primarily used to establish the major parameters upon which the forces in the ring stiffeners depend. The constants that are introduced in the equations of the analytical investigation are evaluated from the experimental results.

The forces in the stiffeners are classified under three types of action, namely: (1) flattening of the cylinder,

(2) bulging of the cylinder, and (3) separate effect of the local loading.

The flattening of the cylinder is due to the inward vertical forces caused by the longitudinal elastic curvature. These inward forces are the resultant forces of the longitudinal stresses in both the compression and tension regions of the cylinder and are proportional to $(1/\rho)^2$ where ρ is the radius of curvature of the longitudinal elastic curve. The bulging of the cylinder is caused by the increase of the radii in the compression half and a decrease in the tension half of the cylinder due to Poisson's ratio. The distortions in the cross-sections of the cylinder, due to the bulging effect, produce primarily normal forces in the ring stiffeners. Both the flattening and the bulging effects are studied from the pure bending moment tests on the cylinder.

The separate effect of the local loading is investigated by eliminating the effects of flattening and bulging which are known from the pure bending moment tests on the cylinder.

Approximate formulas are developed to establish the magnitude and distribution of the forces on the ring stiffeners due to the three types of action listed above. These formulas are approximate insofar as they only involve what is believed to be the major parameters of the problem and insofar as the constants of these equations are evaluated by the use of the experimental results. The use of these formulas is illustrated by computing the stresses in the ring stiffeners of a steel stack. The stresses are computed on the basis of developing the full capacity of the cylinder, a condition which is recommended by the writer in the design of ring stiffeners in steel stacks.

Although this dissertation is concerned with the stresses and not with the rigidity of the stiffener, yet, rigidity is discussed and is related to both the stress in the stiffener and to its depth.

In conclusion, it can be stated that this dissertation presents equations that can be used satisfactorily to establish the character and magnitude of the forces acting on the ring stiffener in long thin-walled cylinders subjected to bending. The results obtained by applying these equations to the ring stiffeners in steel stacks are reasonable and fall within current engineering practice.

Microfilm $2.00; Xerox $5.80. 116 pages.

ENGINEERING, ELECTRICAL

CHARACTERISTICS AND APPLICATIONS OF A JUNCTION HALL MULTIPLIER.

(L. C. Card No. Mic 59-4437)

Bent Christensen, Ph.D.
University of Pittsburgh, 1959

The junction Hall multiplier (JHM) is a semiconductor device which is still in the laboratory stage of development. The applicability of this device has been evaluated on the basis of data derived from measurements on an experimental unit. The data include the direct current characteristics and the small signal alternating current characteristics.

Basically, the JHM has two input ports and one output port. The output signal is a function of the two input signals. These signals are a base current and a magnetic field.

The direct current transfer characteristics, input characteristics, and output characteristics of the JHM have been measured at five ambient temperatures in the range -10° C, to 45° C. In general, the characteristics depend strongly on temperature. The short-circuit, output currents depend not only on the product of the base input current and the magnetic field input but also on the square of the base input current when this current is within a certain range centered around zero.

The alternating current characteristics are expressed by the parameters of a circuit model or equivalent circuit. This equivalent circuit is a six-terminal active network and it has been derived in terms of 30 parameters which are elements of the indefinite admittance matrix of the network. The parameters have been measured at ambient temperatures in the range -10° C. to 45° C., at various bias conditions, and at frequencies up to 10000 cps. Most of the parameters depend strongly on the ambient temperature. The upper limit of the useful range of frequencies may in some applications be as high as 10000 cps for the device tested.

The strong temperature dependence of the characteristics seriously limits the practical applications of the device. A promising application is a low level d-c to a-c inverter which has been investigated experimentally.

The inverter circuit includes a differential amplifier stage using two transistors. A model of this inverter operates at input levels down to 10^{-10} watts. The lower limit is set by the flicker noise generated in the JHM and in the differential amplifier. The frequency of the output signal is 60 cps.

The low level d-c to a-c inverter using the available JHM is not considered to be competitive to more conventional inverters. However, by the proper design of a JHM for this application, the performance of the inverter can possibly be made competitive.

Although a power gain greater than one may be obtained with the JHM, it shows little potential as an amplifying device.

Microfilm $2.80; Xerox $9.80. 216 pages.

SECONDARY ELECTRON MULTIPLICATION IN MICROWAVE FIELD.

(L. C. Card No. Mic 59-4508)

Frank Fu Fang, Ph.D.
University of Illinois, 1959

The electron dynamics of a periodic secondary electron multiplication process at microwave frequencies known as "multipactor" is analyzed theoretically and experimentally.

A) Theoretical

The initial velocity distribution of the secondary electrons is taken into account, and the conditions for the

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

multipactoring process are derived. The dynamic behavior of the electrons in the interaction space is examined in detail, particularly the velocity and energy of the electrons at the arrival plane. In dynamic equilibrium, the system is characterized by the behavior of the "focal electrons" at the "focal phases," and the velocity and energy distribution functions of these electrons at the arrival plane for different operating conditions are derived.

The limitation of the electron multiplying process due to space charge effects is described and a relation between the space charge limited electron density n_i, the time dispersion of the secondary electron emission process, τ, and the secondary emission yield, δ, is established.

B) Experimental

First, methods for treating the secondary electron emitting surfaces are described and it is found that the surface conditions change rapidly in a multipactor operated in high vacua ($\sim 10^{-7}$ mm Hg). However, the life time of secondary emission surfaces is greatly prolonged by appropriate treatment and operating the system in ultra-high vacuum ($< 10^{-9}$ mm Hg).

As operating frequency for the experimental multipactor a frequency of 3 kmcps was chosen. The microwave components and the experimental techniques employed are described in detail.

Distinctive switching action at certain levels of input power is observed as predicted by the theory presented herein. The detailed dynamic behavior of the multipactoring electrons is observed by the application of an electron-beam-analyzer, a brief description of which is given, and the so observed velocities and energies of the electrons as functions of the arrival phase are presented. From these measurements the time dispersion of secondary electron emission is estimated by be $\sim 3 \times 10^{-14}$ seconds.

The excellent agreement between theory and experiment in the energy spectrograms and the energy distribution functions indicates the decisive role the velocity distribution of the secondary electrons plays in the dynamics of the multipactor process. The electron cloud in the multipactor is experimentally as well as theoretically shown to be only moderately bunched in contrast to the general belief that electrons in a multipactor operating at "synchronism" would eventually converge to an almost infinitely tight bunch.

Microfilm $2.00; Xerox $6.20. 127 pages.

A SMALL-SIGNAL FIELD-THEORY ANALYSIS OF CROSSED-FIELD AMPLIFIERS.

(L. C. Card No. Mic 59-4924)

Bernard Hershenov, Ph.D.
University of Michigan, 1959

This study is a small-signal field-theory analysis of the forward-wave interaction of an electron stream, in crossed d-c electric and magnetic fields, with a slow TM-wave. The analysis treats the input-boundary problem and the circuit susceptance in a new way.

The differential equation describing the perturbed electron stream model is derived in a general manner and is then reduced to the well-known slow-wave form. The solutions of this equation are expressed in power series expansions in the neighborhoods of the synchronous and cyclotron singularities. The slow-wave structure is represented as a smooth, lossless dielectric sheet. The circuit susceptance is expressed in terms of the propagation constants of the resultant waves. The fields in the stream are matched to those outside, and dispersion equations for both the near-synchronous and the cyclotron waves are obtained.

The near-synchronous dispersion equation is solved for both thick and thin streams in the presence and absence of a slow-wave circuit.

The cyclotron-wave dispersion equation is solved for a thin stream.

The input boundaries are matched so as to account for the effect of the cut-off waves. A variational procedure is applied to both a modulated and an unmodulated electron stream entering a slow-wave structure and drift region. The energy density in the cut-off waves at the input plane is minimized.

The results for the near-synchronous dispersion equation indicate that the effect of the a-c charge density within the electron stream is very small in comparison to that of the rippled stream boundaries insofar as the r-f interaction is concerned. The bulk a-c charge density is responsible for only a slight increase in the gain of a crossed-field device. In the past it had been assumed that the cyclotron waves see the anode as a perfectly conducting sheet. The retention of the circuit susceptance dependence on the propagation constant in treating the cyclotron waves demonstrated that such an approximation is very poor, except in one small region.

The input-boundary match employing the variational method avoids the usual approximate match which is made at only one or two levels in the stream. The inclusion of the cut-off waves introduces a change in the amplitudes and the phases of the near-synchronous waves. In the particular example given in the test, the amplitudes were slightly less in magnitude and shifted in phase when compared with a match made at only one level in the stream. This method can be applied to the crossed-field backward-wave oscillator and could account for the discrepancy between the experimentally observed and the theoretically derived start-oscillation conditions. The variational method is applied to both modulated and unmodulated streams. The results determine the near-synchronous wave amplitudes and also allow for the determination of the forward-wave start-oscillation conditions. Microfilm $2.15; Xerox $7.60. 163 pages.

THE DEVELOPMENT OF THE COMPLETE TRANSIENT EQUATIONS FROM THE GENERAL EQUATIONS OF ARMATURE REACTION AND INDUCED VOLTAGE.

(L. C. Card No. Mic 59-4295)

Hu-Hsien Hwang, Ph.D.
Lehigh University, 1959

The primary object of this dissertation is to present a unified development of the complete transient equations of

a synchronous machine from the general equations of armature reaction, torque, and induced voltage. Emphasis is on a more or less rigorous mathematical development and on obtaining a complete analysis of the transient performance of a synchronous machine.

The general equations of armature reaction and induced voltage have been introduced by Professor L. V. Bewley. The general equation of induced voltage recognizes the simultaneous movement of conductors, variation of the space flux, and movement of the field, which includes as special cases all the processes of voltage induction to be found in any machine. The general equation of armature reaction applies to A. C. machines as well as to D. C. machines.

This dissertation contains four chapters. The first chapter deals with the performance of a salient pole synchronous machine. A set of complete equations showing the relations among the speed, voltages, currents and torque have been developed by the general equations of armature reaction and induced voltage. The two reaction theory has been applied. In Chapter II certain aspects of the steady state performance have been discussed in detail. A vector diagram has been developed. Chapter III deals with the case of three-phase short circuit. The rigorous and approximate solutions for the short circuit currents, field excitation, and torque have been given. The Laplace Transform calculus has been used in the mathematical treatment. In Chapter IV the unbalanced short circuit cases have been discussed. The moving reference axes, and the α-, β- and O-axis quantities have been introduced. A line-to-line short circuit case has been solved in considerable detail. An approximate solution for the non-linear differential equations with variable coefficients has been proposed. In Appendix A the Laplace Transform impedances have been defined, and the subtransient and transient reactances have been identified as well. The Fourier series expansion formulas have been given in Appendix B.

Microfilm $2.00; Xerox $4.80. 94 pages.

AN ANALYSIS OF FLUID-POWERED CONTROL SYSTEMS AND A STUDY OF THE EFFECTS OF FLUID TRANSMISSION LINES.

(L. C. Card No. Mic 59-4997)

Kenneth Arnold Stone, Ph.D.
University of Michigan, 1959

This dissertation presents an analytical study of high pressure fluid-powered control systems with transmission lines between the control valve and the actuator. The purpose of this study is to derive the equations of motion for these systems, to examine the effects of the transmission-line parameters on the system performance, and to determine if the effects due to the lines may be utilized to improve the system performance or if optimization of the line parameters is possible. The study includes both hydraulic and pneumatic systems.

A unified approach is used in the development of the fluid flow equations for both of the systems. The fundamental properties of fluid flow are applied, in conjunction with the empirical relationships of liquids and gases, to hydraulic and pneumatic systems. The treatment of the equations of fluid flow is such that linearization is justifiable for both types of systems. Analyses of simplified hydraulic and pneumatic systems are included for completeness.

Transfer functions are derived for fluid-powered control systems with fluid transmission lines within the servo loop. These functions are transcendental and are identical in form for both hydraulic and pneumatic systems. Using these transfer functions, studies are made to determine the effects of the line parameters on the system performance and to determine the best set of line parameters in relation to system stability.

Two complex transcendental equations arise in this analysis, and a method is developed for determining the roots of these equations. Regions for the location of the roots of the transcendental functions which occur for the types of systems considered in this thesis, as well as in R-L-C transmission line problems, are specified in terms of the line parameters and the characteristics of the terminating load. The equations for instrumentation systems with lines represent a special case of the class of transcendental functions derived for the servo systems, and the method for the determination of the roots of the transcendental equations of this special case is presented. This method provides a relatively rapid procedure for approximating the transcendental functions to any desired degree of accuracy. Use of the results of the special case studies, in conjunction with root loci techniques, provides the method for locating the roots of more complicated transcendental expressions for studying the effects of the line parameters on the servo system performance.

It is concluded from this study that lines, in general, are detrimental to the performance of a high-response servo system. However, in the event that long lines cannot be avoided, a range of line parameters exists which defines the "best" line for the system. Furthermore, it is shown that an optimum "matched" line exists for which the effects of the line parameters are reduced to pure time delay. This optimum line is obtained by matching certain parameters of the control valve to the characteristic line impedance. Although this method of optimization is essentially a compensation scheme, it is considered most important because it eliminates all effects attributable to the lines, except for the inherent transmission time delay.

The analysis of the instrument lines is a natural consequence of the work done to evaluate the more complex servo systems. Closed-form solutions are presented for the transient response of these systems under certain conditions. In addition, graphs are presented from which it is possible to design instrumentation systems for a specified frequency response.

"Flow derivatives" are defined and derived in the appendix. These functions are the normalized partial derivatives of the flow of air through an orifice with respect to the pressure on either side of the orifice. The flow derivative functions are presented in graphical form, and should eliminate some of the tedious work involved in the dynamic analysis of pneumatic systems.

Microfilm $2.00; Xerox $6.60. 139 pages.

ACTIVE NETWORK SYNTHESIS BY LATTICE REDUCTION.

(L. C. Card No. Mic 59-4577)

Roland Everett Thomas, Ph.D.
University of Illinois, 1959

The standard lattice synthesis technique is extended to active networks in which the available network elements are positive and negative resistors and capacitors. The designation of the immittances of the arms of the active lattice as "single NIC realizable" is shown to be useful and to lead to a variety of lattice realizations including the constant-resistance lattice. The general method described for synthesizing the active lattice requires the introduction of a surplus factor with real, simple and negative zeros.

Several procedures are given for reducing the active lattice to an unbalanced equivalent two port made up of resistors, capacitors and negative impedance converters. Both reciprocal and non-reciprocal reductions are obtained. NIC biasing provisions and termination conditions are met by inserting appropriate immittances into the lattice at an appropriate stage of the reduction process.

A useful procedure for reducing the alignment problem is cascade synthesis. For first and second order transfer functions, it is established that the active constant-resistance lattice can be obtained without introducing a surplus factor. This leads to a method of constant-resistance cascade synthesis which is competitive with other methods from the standpoint of the number of active elements required and in which the NIC is the only active structure. An example of cascade synthesis is given and the different possibilities compared.

To introduce the element of practicality into the lattice procedure, the sensitivity functions for both active and passive elements are derived for several possible reductions of the lattice. It is shown that the sensitivity properties of the final network can be controlled by selection of the reduction method and the surplus factor associated with the synthesis of the active lattice. The surplus factor can often be determined by the Horowitz procedure and then modified by trial and error to improve the sensitivities of the poles of the transfer function. It is further established that the only valid evaluation of the sensitivity properties of the active constant-resistance lattice is in terms of classical sensitivity since the poles of a constant-resistance lattice always have infinite root sensitivity. A number of examples of sensitivity computations are given to illustrate the theory.

Microfilm $2.00; Xerox $5.00. 100 pages.

TRANSPORT OF NOISE AT MICROWAVE FREQUENCIES THROUGH A SPACE-CHARGE-LIMITED DIODE.

(L. C. Card No. Mic 59-5006)

Weston Edward Vivian, Ph.D.
University of Michigan, 1959

Several analyses of the transport of cathode shot noise through a space-charge-limited diode at microwave frequencies have been published in past years. None, as yet, has been free of major inconsistencies — particularly inconsistencies arising from assumptions of monovelocity perturbation flow, direct or reflected. Several new methods of analysis of this problem are presented here. Attention is restricted to the now-classical problem of one-dimensional longitudinal confined flow.

Numerical results, based for economy on an approximate static flow model, are presented for several illustrative diode operating conditions. The magnitude and variation with distance of the so-called beam noise invariants is shown. These calculated results essentially substantiate the qualitative expectations suggested by prior, cruder analyses, and by what little experimental and simulation data are available.

The method of analysis employed in calculation of the numerical results comprises a linear multistream formulation, based on representation or approximation of the perturbation particle density for the noise flow as a composite of singular impulse streams, N in number, along characteristic trajectories in the velocity-distance phase space. The set of N coupled first-order ordinary linear differential equations resulting is solved by simultaneous numerical extrapolation. Because the boundary conditions which the solutions must satisfy are manifested at N different locations in the phase space, it proves necessary in the numerical calculations first to obtain N independent subsolutions of the set, then superpose these such that all the requisite boundary conditions are satisfied jointly. A key boundary condition to be satisfied, occasioned by the potential minimum, is that the singular current flow at zero velocity at the potential minimum vanish identically. This condition, employed here, though it may seem obvious, was not accessible in the prior analyses, and led to serious inconsistencies therein.

The relationship of the method of analysis developed to the several methods of Watkins and Siegman, of Knipp, and of Landau, is explained. Techniques for modifying and extending the method to avoid need for introducing singular flows are outlined. The techniques discussed include an iterative technique, formulation of a one-dimensional integral equation by use of the method of characteristics, and several expansions in orthonormal flow modes. The relative merits and deficiencies of the several methods are compared.

Microfilm $2.00; Xerox $5.20. 105 pages.

ENGINEERING, HYDRAULIC

PRESSURE DISTRIBUTION IN POROUS MEDIA DURING UNSATURATED FLOW

(L. C. Card No. Mic 59-4865)

Verne Harry Scott, Ph.D.
Colorado State University, 1959

A theoretical analysis was made of steady flow of two immiscible fluids through porous media. The theory developed was based on the simultaneous application of

Darcy's equation to both phases. Interfacial forces were introduced by consideration of the difference in pressure between the non-wetting and wetting phase.

A differential equation in terms of scaled variables was derived to express the variation in pressure in any direction within the media. A series of experiments using an oil-air system were conducted to test the validity of the theory. Steady-state flow was maintained by controlled pressure at the inlet and outlet of a long column. Tension in the fluid was measured at frequent intervals by especially designed tensiometers made from Porvic plastic. Experiments involving upward and downward flow, change in slope, reduction and increase in flow, and stratification were conducted. For each of the cases investigated the flow was one-dimensional.

Experimental results were compared with the theory and good agreement was found for all cases tested. Application of results to oil exploration and production and soil-water problems are discussed.

Microfilm $2.35; Xerox $8.20. 177 pages.

AN INVESTIGATION OF CORNER EDDIES AND FREE-SURFACE INSTABILITY.

(L. C. Card No. Mic 59-4992)

Aris Constantine Spengos, Ph.D.
University of Michigan, 1959

The phenomena investigated in this study are: (a) the formation of corner eddies immediately preceding an abrupt contraction in the flow area, (b) the instability of a free surface due to a downward acceleration, and (c) the instability of a free surface due to an abrupt change in boundary geometry. It has been observed that the occurrence of these phenomena in a Fourdrinier paper machine affect adversely the quality of the paper produced.

It is analytically demonstrated that the formation of corner eddies upstream from the discharge opening of the head box of a paper machine is partly the consequence of the rotationality of the upstream flow. The differential systems for two cases of two-dimensional flow, with appropriate boundary conditions for the flow in the head box, and their solutions are presented. The effect of viscosity has been considered partially, and a sine velocity distribution has been assumed for the flow far upstream. Because the formation of the eddies does not originate far upstream the solutions obtained are valid for the flow outside the corner eddies only.

The analysis of the instability of a free surface when it is subjected to a downward acceleration larger than that of gravity is carried out for three-dimensional disturbances. Surface tension and depth of fluid have been taken into consideration, but the effects of the Coriolis acceleration and viscosity have been neglected. The linear and non-linear solutions of the differential system, consisting of Laplace's equation and the appropriate boundary conditions, are obtained. Data collected with the use of an experimental apparatus simulating flow conditions in a paper machine verify the trend predicted by the analysis.

The experimental investigation of the instability due to an abrupt change in the boundary geometry was carried out with the same experimental apparatus. The results indicate that the growth of the disturbances depends on the degree of change of the boundary geometry, and on Froude number. Microfilm $2.00; Xerox $3.60. 62 pages.

ENGINEERING, MECHANICAL

THERMAL EFFECTS IN JOURNAL BEARINGS.

(L. C. Card No. Mic 59-4873)

Elsayed Morsi Aly Afify, Ph.D.
University of Michigan, 1959

The purpose of the present investigation is to explore some of the aspects not discussed by most of the previous investigators in the field of lubrication. Both the heat conducted through the bearing and that convected by the oil flow were considered in the study of the effect of speed, load, and external heating on the average oil film temperature, oil flow, and correspondingly the heat balance of journal bearings.

For this investigation, a simple journal bearing was constructed with oil fed at a constant pressure of one psig through a single hole placed at the unloaded side of the bearing. Twelve thermocouples were placed flush with the inner surface of the bearing to measure the temperature along the axial as well as the circumferential direction. A slip-ring and brush arrangement was used in the measurement of the journal surface temperature at four different positions. Devices for loading the journal and varying the speed of rotation were provided. A method of detecting metal-to-metal contact between the journal and the bearing was used and means of measuring the oil flow rate and the inlet and outlet oil temperature were also provided.

Three series of tests were conducted from which the heat convected by the oil flow and the heat dissipated through the bearing and housing were determined for different combinations of speed and load.

As a result of this study a better understanding of the effect of load, speed, and external heating on the heat dissipated through the bearing and that convected by the oil flow was achieved.

The phenomenon, that the bearing will run cooler at light loads than at no-load was established and confirmed experimentally. The average oil film temperature was affected more by variations in speed than by variations in load. The oil flow rate was influenced more by changes in load than by changes in speed. The heat convected by the oil flow increased by external heating application.

A mathematical treatment of the unloaded bearing was derived, while experimental correlations from the test results were obtained to calculate the heat convected, the heat dissipated, and the oil flow rate. A method for estimating the average temperature of the bearing was also presented. Microfilm $2.00; Xerox $6.20. 129 pages.

THE ONSET OF LAMINAR NATURAL CONVECTION IN A FLUID WITH HOMOGENEOUSLY DISTRIBUTED HEAT SOURCES.

(L. C. Card No. Mic 59-4901)

Walter Ralph Debler, Ph.D.
University of Michigan, 1959

In this thesis the thermal instability (in the sense of secondary flow) of a horizontal layer of fluid that has homogeneously distributed heat sources is examined. It is shown that the onset of laminar natural convection is determined by a critical Rayleigh number, $g\alpha(\textcircled{H}_M - \textcircled{H}_o)b^3/\nu\kappa$, in which g is the gravitational constant, α is the coefficient of thermal expansion, $(\textcircled{H}_M - \textcircled{H}_o)$ is the difference between the temperature at the upper boundary and the maximum temperature in the fluid, b is the depth of the fluid layer, ν is the kinematic viscosity, and κ is the thermal diffusivity. Graphs relating the Rayleigh number and the cell number are presented for three cases; (a) both bounding surfaces rigid and isothermal, (b) a rigid adiabatic lower boundary and a rigid isothermal upper boundary and a rigid isothermal upper boundary and, (c) a rigid adiabatic lower boundary and a free isothermal upper surface.

In this way it is shown that the degree of stability of a fluid layer is dependent on the manner in which the velocity at the horizontal boundary is prescribed. A layer with a free surface was found to be less stable than if the boundary were rigid. The influence of the mean temperature distribution is also discussed. An experiment was conducted to verify the analysis for case (a), above. Emperical values of the critical Rayleigh number were 12600, 7700, and 5800 for fluid depths of 3/4, 1/2 and 1/4 inches, respectively. The theoretical value is 4672.

The governing equations, boundary conditions and some computational coefficients are presented for other problems which are related to those treated. The results for the problems studied should have application to the design of atomic reactors which employ radioactive fluids.

Microfilm $2.00; Xerox $5.40. 107 pages.

FLAME STABILIZATION IN THE BOUNDARY LAYER ON A POROUS FLAT PLATE.

(L. C. Card No. Mic 59-5303)

Alan Quade Eschenroeder, Ph.D.
Cornell University, 1959

The position and stability of the flame in a low-speed boundary layer with uniform mixture injection from a porous wall parallel to a uniform air stream were determined under the conditions of laminar steady flow with zero streamwise pressure gradient.

Solutions of the boundary layer equations with combustion were obtained. The location and enthalpy of the single diffusion controlled flame were found by determining the local downstream velocity at the combustion zone, and the same methods were applied to the double-branched or bifurcated flame. An analysis of the ignition point stability was carried out for a one-step reaction governed by second order kinetics. The diffusion controlled models indicated that the downstream distance from the leading edge of the plate to the flame front should decrease with increasing fuel concentration for injected mixtures immediately on the rich side of stoichiometric, whereas the reaction controlled model showed just the opposite trend. Because the flame served as its own source of ignition energy, the latter model was believed to be more applicable than the former.

Experimental studies were made with a small combustion tunnel. Propane-air flames on the porous wall of the test section were observed over a free stream velocity range of 10 to 42 feet per second and a range of mass equivalence ratios for the injected mixture from 1.09 to 4.76. Both the average and the time variant flameholding distances were measured at various free stream air mass fluxes, injection mass fluxes, and injected fuel concentrations. With two dimensional flames, the dimensionless flameholding distances varied with fuel concentration in the manner predicted by the reaction limited theory in the range of equivalence ratios from about 1.1 to 1.7. For mixtures richer than these, non-isotropic flames with deep frontal indentations were observed. Instabilities prevented flameholding with fuel concentrations above an equivalence ratio of 4.76. Several turbulent flames were obtained over a wide range of Reynolds numbers. The relationship of turbulent flameholding to the disappearance of turbulent shear at the wall seemed analogous to that displayed in the laminar case.

For predicting flame stabilization distances in boundary layers with uniform mass addition, the length required for vanishing shear at the wall is a practical lower limit. Only mixtures richer than stoichiometric will support a flame when they are injected from a porous wall into a boundary layer. Since two dimensional flames occur only near the stoichiometric concentration, the flame stability can describe the holding mechanism in this region. Much richer mixtures result in non-isotropic flames. The upper limit of richness is fixed by the blowout of non-isotropic flames due to turbulent contamination. Flameholding in the turbulent boundary layer is possible, but the distance from the leading edge to the flame is far greater than that for laminar burning.

Microfilm $2.40; Xerox $8.40. 183 pages.

LIMIT OF SUPERSATURATION OF NITROGEN VAPOR EXPANDING IN A NOZZLE.

(L. C. Card No. Mic 59-4913)

Gennaro Louis Goglia, Ph.D.
University of Michigan, 1959

An experimental investigation was conducted to determine the limit line of supersaturation of superheated nitrogen vapor as it expanded in a supersonic nozzle. An aluminum, two dimensional source-flow, adjustable throat type of nozzle of one inch width was used in these tests.

The nitrogen used in the tests was stored in a tank which was surrounded by a bath of liquid nitrogen. The thermal capacity of the tank and that of the bath of liquid nitrogen surrounding the storage tank permitted the generation of the nitrogen vapor. While equilibrium conditions were being attained in the storage tank liquid nitrogen

was forced through the line connecting the tank with the nozzle-diffuser assembly. By this procedure it was possible to maintain the temperature conditions at the nozzle inlet as close to the saturation conditions as was possible.

The establishment of the limit line required a method of detection of the onset of condensation. The pressure measurement method was chosen because of its accuracy as well as its simplicity. This procedure required the measurement of the static pressure variation along the nozzle block as well as the stagnation pressure variation along the center-line of the nozzle. The onset of condensation was noted as the tangential departure point of the actual expansion from the isentrope.

The results indicate that the superheated nitrogen vapor became supersaturated when expanded in the straight wedge type nozzle. The number of degrees of supersaturation experienced ranged from approximately 3.5°R for reservoir conditions of 4.38 atmospheres pressure and 234°R temperature to a value of approximately 12.3°R for reservoir conditions of 13.22 atmospheres pressure and 340°R temperature. Additional test runs were conducted at 6.09, 7.80, 9.15, 9.84, 10.60 and 12.90 atmospheres reservoir pressures. The degree of supersaturation increased with an increase in reservoir temperature for a given reservoir pressure whereas it decreased with an increase in reservoir pressure for a given reservoir temperature. There was evidence from run number 130-6 that the number of degrees of supersaturation is decreased as the result of the presence of foreign impurities in the flow.

The experimental results indicated rather conclusively that the condensation of the nitrogen was gradual and that there was no evidence of a condensation shock. It was evident that the flow up to the onset of condensation was isentropic and that the stagnation pressures along the nozzle axis as measured were almost those predicted for isentropic conditions. It was also observed that once the collapse of the supersaturated state occurred the flow process appeared to parallel the saturated expansion.

A mass spectrometer analysis of the nitrogen used indicated the presence of approximately five percent oxygen content. Two test runs conducted with a higher purity nitrogen revealed no appreciable effect on the amount of supersaturation obtainable. It appeared, therefore, that a limit of supersaturation was observed and that the nitrogen may have condensed due to self-nucleation. A limit line of supersaturation curve for this range of study was then plotted. By means of this plot predictions of the position along the nozzle wherein condensation would be expected to commence as well as the number of degrees of supersaturation to be expected for given initial reservoir conditions could be made.

The results of this study appeared to favor the acceptability of the Stever-Rathbun theory.

Microfilm $2.00; Xerox $7.20. 152 pages.

THE PRESSURE DEPENDENCE OF LAMINAR BURNING VELOCITY.

(L. C. Card No. Mic 59-4143)

Leonard Baldwin Graiff, Ph.D.
Purdue University, 1959

Major Professor: John T. Agnew

The effect of pressure on the burning velocity of seven stoichiometric fuel-oxidant mixtures was determined using the constant-volume bomb method. An ionization gap technique was used to obtain flame radius-time data. The pressure range investigated was from 0.2 to 20 atmospheres. Burning velocity values were calculated from flame speed measurements using the recently developed equations of Eschenbach and Agnew.*

Preliminary tests indicated that precautions must be taken to control the spark energy somewhat if the ionization gap technique of measuring flame speeds is used. It was also found that the flame speed measurements of some mixtures, particularly at low pressures, could be affected by the ionization gap electrodes. An experimental test technique was devised which apparently eliminated any effect of the spark energy or ionization gap electrodes from the calculated value of the flame speed.

The burning velocities of stoichiometric mixtures of methane-air, propane-air, and ethylene-air were found to be inversely proportional to the logarithm of the pressure within the pressure range investigated: $\frac{1}{2}$ to 20 atmospheres. For this pressure range, the burning velocity, S_u, of methane-air was represented quite accurately by

$$S_u = -6.78 \ln P_i + 32.9 \quad \text{(cm/sec)}$$

Within the pressure interval of $\frac{1}{2}$ to 10 atmospheres, S_u of ethylene-air was given by

$$S_u = -4.34 \ln P_i + 59.8 \quad \text{(cm/sec)}$$

Above 10 atmospheres pressure, the burning velocity of ethylene-air appeared to decrease more rapidly. The burning velocity measurements of propane-air indicated a change in pressure dependence at about 5 atmospheres. S_u decreased from 35.5 cm/sec at $\frac{1}{2}$ atmosphere to 28.5 cm/sec at 5 atmospheres. At 20 atmospheres pressure, the computed burning velocity was 19.6 cm/sec.

The burning velocity of stoichiometric acetylene-air was determined at pressures from $\frac{1}{2}$ to 10 atmospheres. From $\frac{1}{2}$ to 2 atmospheres, the burning velocity, which was essentially independent of pressure, had an average value of 125 cm/sec. At pressures above 2 atmospheres, a small increase in burning velocity with pressure was indicated.

The flame speeds of stoichiometric hydrogen-oxygen were measured for pressures from $\frac{1}{2}$ to 5 atmospheres. The calculated burning velocity increased rapidly with pressure: from 902 cm/sec at $\frac{1}{2}$ atmosphere to 1797 cm/sec at 5 atmospheres.

Stoichiometric methane-oxygen and ethylene-oxygen exhibited somewhat similar burning velocity pressure dependence: little or no dependence at low pressures and strong positive dependence at higher pressures. S_u of methane-oxygen increased from 380 cm/sec at atmospheric pressure to 468 cm/sec at 2 atmospheres. The burning velocity of ethylene-air increased from 493 cm/sec at $\frac{1}{2}$ atmosphere to 719 cm/sec at 2 atmospheres pressure.

The flame speed of stoichiometric acetylene-oxygen at an initial pressure of one atmosphere was also measured. The calculated value of the burning velocity was 1215 cm/sec.

Experimental determinations of the burning velocity at atmospheric pressure compared favorably with literature values. Microfilm $2.00; Xerox $6.40. 134 pages.

*R. C. Eschenbach and J. T. Agnew, "Use of the Constant-volume Bomb Technique for Measuring Burning Velocity," Combustion and Flame, vol. 2, no. 3, 1958, p. 273.

AN INVESTIGATION INTO THE STABILITY OF A STEADY STATE VIBRATORY SYSTEM GOVERNED BY THE NONLINEAR DIFFERENTIAL EQUATION

$$m\ddot{x} + c\dot{x}\dot{x} + ax = F_0 \cos \nu t.$$

(L. C. Card No. Mic 59-4965)

Bernard Morrill, Ph.D.
University of Michigan, 1959

The purpose of this investigation is to determine the stability of a steady state vibratory system which has the characteristic of nonlinear damping as represented by the differential equation

$$m\ddot{x} + c\dot{x}\dot{x} + ax = F_0 \cos \nu t. \quad (1)$$

The importance of this investigation lies in the technique developed for analyzing a system with nonlinear damping; a technique which may also be applied to systems which are governed by nonlinear damping which is of a form other than that given by Equation (1).

Chapter I of this investigation develops a stability criterion which may be applied to any nonlinear system represented by a second order nonhomogeneous differential equation, providing such a system has a periodic solution. If a system has a bounded solution and the forcing function is periodic, its solution will be periodic and may be represented by a Fourier series. By giving a perturbation to the periodic solution, there results a linear differential equation in the variable of the perturbation. The resulting differential equation is a Hill type equation. By assuming an approximate solution for the Hill type equation, the characteristic exponent of the perturbation variable may be evaluated. If the characteristic exponent is imaginary the system is stable; if real, the system is unstable.

Several assumed solutions for Equation (1) are developed in Chapter II, one of which is a solution containing a subharmonic of the one half order. The assumed solutions are in the form of truncated Fourier series, since a full series is too cumbersome to deal with mathematically. On the basis of these assumed solutions the characteristic exponents are evaluated and the conditions for stability are predicted.

A comparison of the predicted instabilities with the points of instability as determined by an analogue computer is made in Chapter III. The predicted instabilities check closely with the test results for a wide range of frequency inputs. The results are less reliable for low frequencies and fail to accurately predict the instability for very low frequencies. For the high frequency range at or above resonance, it is demonstrated that two types of solutions exist; a stable and an unstable solution exists, depending upon the initial conditions of the solution. When the response to the vibration in the high frequency range takes the form of a subharmonic of the one half order the system is unstable whatever the value of F_0. On the other hand, if the initial conditions are such that the wave form is the fundamental of the harmonic, the system is a stable one and will only become unstable when F_0 becomes sufficiently large.

It is also demonstrated that unstable solutions may also exist in the frequency range below resonance. Whether a solution is stable or unstable depends upon the initial conditions.

It may be concluded from the results of this investigation that the stability of the system defined by Equation (1) may be predicted over a wide range of amplitude and frequency inputs. The accuracy of the predictions are well within the range of accuracy of the engineering estimate of the values of the constants in Equation (1).

Microfilm $2.00; Xerox $3.00. 60 pages.

THE DYNAMIC FRICTIONAL CHARACTERISTICS OF MOLDED FRICTION MATERIALS.

(L. C. Card No. Mic 59-3217)

Michael Jerome Rabins, Ph.D.
University of Wisconsin, 1959

Supervisor: Professor Ralph J. Harker

A number of molded materials have been developed in recent years for the generation of high frictional forces when contacting dry metal, the principal application being in brakes and clutches. The purpose of the present study is to obtain information concerning the frictional behavior of these materials.

Two independent testing procedures are described that enable the measurement of the coefficient of friction of different materials under varying operating conditions. The normal load, relative velocity, temperature and surface conditions are controlled in both methods. In the first test, friction specimens are rubbed against the outside of a six inch diameter drum, and in the second test the specimens are rubbed against the inside of a three inch diameter drum. Although the testing ranges of the two methods overlap, the first test procedure is designed primarily for high normal loads and relative velocities and the second for low loads and speeds. The results from the two methods prove to be reproducable in the overlapping test range. The specimens tested are commercially available molded friction materials.

The following results pertain to all materials tested:

(a) The coefficient of friction decreases with increasing normal load, obeying the relationship

$$(\mu - c_1) = c_2 (F_n)^{c_3}$$

where μ is the coefficient of friction, F_n is the normal load and c_1, c_2 and c_3 are constants which

may be determined from a logarithmic plot of μ versus F_n;

(b) The coefficient of friction is essentially independent of relative velocity showing only a slight decrease with increasing velocity;

(c) The value of the coefficient of friction depends upon the presence of a deposited microscopic intersurface that approximately doubles the frictional capacity;

(d) The coefficient of friction is independent of temperature below 500°F. At higher temperatures the intersurface mentioned in part (c) apparently breaks down;

(e) The coefficient of friction is independent of apparent normal area of contact except that when the specimen width, perpendicular to the direction of relative velocity, decreases below a certain minimum the coefficient tends to decrease;

(f) The coefficient of friction is independent of the surface finish of the mating metal if the friction material has been allowed sufficient operating time for stabilization;

(g) The coefficient of friction is essentially the same for all frictional materials tested;

(h) Harder metals yield a higher coefficient of friction in that they seem to offer more support for the operational surface film.

Suggested interpretations of the above characteristics are offered in the light of current theories of frictional phenomena.

An analysis of a centrifugal friction clutch is presented as an example of how the variation of μ with F_n might be employed in a specific design situation.

Microfilm $2.00; Xerox $6.60. 139 pages.

HEAT TRANSFER IN EXTENDED SURFACES WITH INTERNAL HEAT GENERATION.

(L. C. Card No. Mic 59-4739)

Fuad Tawfik Saadeh, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Byron E. Short

An investigation was made of extended surfaces with internal heat generation by the classical analytical method and by electrical analogy. In the analytical approach, two-dimensional treatment was attempted and found to lead to complex and impractical relations. Applying the usual one-dimensional approach, relations were obtained for the temperature distribution and effectiveness of fins of regular profiles for which the differential equations are reducible to ordinary, Euler, and Bessel forms.

An electrical network analogue, especially built for this study, was first applied in the solution of the two-dimensional problem of the heat-generating rectangular bar. The results obtained for this case by the electrical analogy were compared with those of the analytical solution in order to determine the accuracy of the network analogy as used here. The results showed that the expected accuracy is of the same order of magnitude as the accuracy of the electrical instruments used, namely, $\pm$ 2 per cent of full scale.

The electrical analogy technique was used to study the following: the applicability of the one-dimensional analytical method including the influence of internal heat generation, the Nusselt number, and fin width to thickness ratio; the influence of internal heat generation on fin effectiveness; and comparison of the effectiveness of several fin profiles. In addition, the effectiveness of the circular fin of triangular profile, for which no analytical expression is available, was obtained and compared with that of the circular fin of rectangular profile.

It was found that the presence of internal heat generation reduces the accuracy of the one-dimensional method. The one-dimensional approach appeared to be as accurate as the two-dimensional analogy up to a thickness to width ratio equal to 0.2. For a thickness to width ratio of 0.8, the discrepancies between the results of the two methods were as much as 26 per cent, increasing with the Nusselt number and internal heat generation.

The fin effectiveness increased in proportion to the rate of internal heat generation in accordance with the ratio bG/hT_0, in which b is the fin thickness, G is the internal heat generation rate, h is the surface conductance, and T_0 is the difference between the fin base temperature and the ambient fluid temperature.

The comparison of various fin geometries revealed that while parabolic and triangular profiles are more effective than rectangular ones without internal heat generation, fins of rectangular profile may become more effective in the presence of appreciable internal heat generation and when the thickness to width ratio is large.

Microfilm $2.00; Xerox $5.20. 104 pages.

EXPERIMENTAL ANALYSIS OF THE MECHANISMS OF HEAT TRANSFER THROUGH FIBROUS INSULATING MATERIALS.

(L. C. Card No. Mic 59-4749)

Joseph Jackson Thigpen, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Byron E. Short

This investigation was undertaken to study the mechanisms of heat transfer through fibrous insulations. The method of analysis employed assumed that the heat flow was along three parallel paths: (1) conduction along or through the fibers, passing from fiber to fiber at points of contact; (2) radiation through the spaces between the fibers and; (3) conduction through the gas filling the voids between the fibers. The influence on these mechanisms by such factors as insulation bulk-density, insulation mean temperature, pressure of the gas in the insulation, and type of gas in the insulation, was analyzed at insulation mean temperatures of approximately 500° F to 600° F.

Four fibrous insulations, three composed of the same type refractory fibers but of different bulk-densities and a fourth composed of asbestos fibers, were tested over a

pressure range from a few microns of mercury to approximately 100 psig. At points in the high and low pressure regions tests were made at insulation mean temperatures both above and below the normal test temperature. Also, one of the insulations was tested with three other gases, helium, neon, and argon, in addition to air filling the space between the fibers.

Test results indicated that the heat conducted along the fibers was primarily a function of the conductivity of the fibers and the bulk-density of the insulation and that it increased as these factors increased. Heat transferred by this mechanism represented only a small portion of the total heat transferred.

The investigation indicated that the heat conducted through the gas in the insulation was dependent upon the fiber spacing and the gas within the insulation. The closer the fibers were to each other, the larger the heat flow by this mechanism per unit of gas volume. Below a critical pressure, which was itself dependent on the fiber spacing, the heat conducted through the gas varied directly with the pressure. Above this critical value the pressure had little or no effect on gas conduction. When gases other than air were used, the heat conducted through the gas varied directly with the thermal conductivity of the gas.

This investigation indicated that the heat transferred by radiation was a function of the fiber material and fiber spacing. The results gave evidence that fiber emissivity was a significant factor in this mechanism of heat transfer. The wide variation in the results of the heat transferred by radiation was most likely due to the difference in the lengths of radiation paths brought about by the different fiber spacing for the different bulk-densities. The greater the distance through the insulation which the infrared waves could move without being intercepted by a fiber, the greater was the heat flow by radiation.

A comparison was made between apparent thermal conductivity values obtained experimentally and values obtained from an equation derived by Nusselt. The agreement was not good. In his derivation Nusselt used a model of a fibrous insulation consisting of a path of solid conduction in series with parallel paths of radiation and gas conduction.

The results of this investigation indicated that a more accurate picture of the heat transfer process through a fibrous insulation was given by a combination of the series-parallel approach of Nusselt and the parallel approach of this investigation. Values of the apparent thermal conductivity obtained from an equation derived from a model based on this scheme checked very closely with values obtained in this investigation and with values given in the manufacturer's literature. The apparent thermal conductivity equation of this model gave a minimum value which agreed with results obtained in this investigation. Microfilm $2.00; Xerox $6.40. 133 pages.

ANALYTICAL AND EXPERIMENTAL STUDY OF THE AXIALLY-SYMMETRIC SUPERSONIC BASE PRESSURE PROBLEM.

(L. C. Card No. Mic 59-4589)

Glen Wallace Zumwalt, Ph.D.
University of Illinois, 1959

Flow model components for the two-dimensional (plane) base pressure problem have been defined and used successfully in the works of D. R. Chapman and of H. H. Korst. However, previous attempts to apply these components to base pressure problems involving axial symmetry have been disappointing. These components which must be specified when supersonic flows separate from, and subsequently reattach to a guiding surface, are: (a) type of turn of the flow in the vicinity of the separation corner, (b) condition of the "dead-air" region, (c) a reference boundary for locating the separated flow in space, (d) a mixing process between the free stream and "dead-air" region, and (e) the recompression phenomenon when the flow reattaches to the wall. A "separating streamline" can be located which (1) divides the mass of the flow passing the separation corner from that recirculating in the (nearly) dead-air region, and (2) divides the streamlines having sufficient kinetic energy to penetrate the pressure rise from those which cannot pierce this pressure barrier but must recirculate. Continuity and momentum integrals in the mixing regions are utilized to locate the streamlines in space and to define this separating streamline. In this thesis the five components are re-examined to determine their applicability to cases involving axial symmetry of flows and bodies. The treatment is limited to isoenergetic separated flows which are supersonic, have turbulent separated shear regions, and whose boundary layers at the separation corners are small compared to other significant lengths.

The two basic types of cases considered are for supersonic flows (1) expanding inside axially-symmetric channels having sudden enlargements in cross-section and (2) expanding around bodies of revolution having sudden reductions in cross-section. The former type was investigated experimentally for flows from five air nozzles having exit Mach numbers from 1.00 to 2.52 and parallel or conical outflow. Measurements of base pressure were made for each nozzle for a variety of area expansion ratios. In addition, the pressures along the downstream wall in the vicinity of the reattachment were measured. For external flow cases, published Schlieren photographs and data were utilized.

Experiments show that internal flow cases have essentially constant pressure in the "dead-air" region. The flow impinges on the expanded wall at about the position predicted by the boundary of an inviscid jet, determined from the potential flow solution, having the same pressure and free stream Mach numbers. This boundary is the one used for the reference system of coordinates. The measured peak pressure rise on the wall at reattachment is lower than that resulting from oblique shock relations except for the $M_{exit} = 1$ jet. Reasons for this reduction are discussed and an empirical expression for the effective pressure rise given. This value is used along with an analytical treatment of the mixing region, utilizing the continuity and momentum integral method mentioned above, and a stipulated mixing

profile. This analysis takes into account the change in flow area with radius change, and assumes constant pressure mixing. Velocity profiles in the separated mixing region are assumed to characterize the mixing process and to be everywhere similar in shape. Three selected profiles are investigated analytically and a decision reached to retain the error function profile (derived for the plane flow turbulent mixing analysis) for the calculation method. Base pressures can thus be calculated which accord with the experimental results.

Several integrals appearing in the analysis are evaluated and presented in graphical form.

Principal conclusions lie in the distinguishing of the two types of axially-symmetric base pressure problems (internal and external) as being different in kind, and demanding separate treatment.

Microfilm $2.00; Xerox $5.60. 112 pages.

ENGINEERING MECHANICS

THE SUITABILITY OF AN ELASTIC-PLASTIC THEORY FOR PREDICTING RESIDUAL AND TRANSIENT THERMAL STRESSES IN HOLLOW CYLINDERS.

(L. C. Card No. Mic 59-4290)

Russell Edward Benner, Ph.D.
Lehigh University, 1959

The objective of this investigation was to determine the suitability of using a static, elastic-plastic theory for predicting the residual stresses arising from transient thermal stresses in hollow cylinders, for the case of contained plastic flow.

Annealed steel cylinders 2"O.D.x1$\frac{1}{2}$"I.D.x5" long were heated to a uniform temperature below the transformation range and were cooled rapidly by a water spray on the inside surface. Two cylinders were cooled, one from a temperature of 477°F and the other from 740°F. A thermocouple, welded to the inside surface, gave a continuous temperature record which was used to calculate the transient temperature distributions required in the theoretical analysis.

A static elastic-plastic theory based on the classical theory for perfectly plastic materials and on Tresca's yield condition was used to predict the residual stresses for this transient case. The theory was extended, in this work, to include the variation with temperature of the coefficient of linear thermal expansion, and a combined numerical-graphical method of calculation was developed in which the variation with temperature of the specific heat, thermal conductivity, yield limit, and coefficient of linear thermal expansion of the material were considered. The modulus of elasticity and Poisson's ratio were considered as constants. Perfect plasticity was approached in the experimental work by the use of annealed mild steel (A.I.S.I.- C1020) as the test material. To provide an evaluation of the theoretical results, the residual stresses which actually existed in the test cylinders were determined by Sachs' boring-out method.

From a comparison of the theoretical with the experimental results, it was concluded that 1) the theoretical prediction of the extent of penetration of the plastic inclusion agreed very closely with experimental results, 2) the theoretically calculated values of the maximum residual stresses at the bore surface of the cylinders were on the order of 25% higher than the values obtained experimentally, 3) at points within the plastic region, where the residual stresses are less than the maximum values occurring at the bore surface, the predicted stresses did not agree as closely with the experimental values, 4) calculations of the residual stresses at the bore surface based on a constant, average value of α gave results which exceeded the stresses calculated on the basis of variable α by 45% and 20% for the cylinders cooled from 477°F and 740°F respectively, and 5) the transient, elastic-plastic stresses at the outside surface of the cylinder, predicted by the same elastic-plastic theory used to calculate the residual stresses, were 50% higher, at the point of maximum deviation, than the experimentally determined transient stresses.

Microfilm $2.00; Xerox $6.20. 130 pages.

EFFECT OF ELECTROMAGNETIC FIELDS ON GRAVITATIONAL STABILITY OF A VISCOUS FLUID.

(L. C. Card No. Mic 59-4885)

Michael Bentwich, Ph.D.
University of Michigan, 1959

Infinitely high columns of viscous fluids are known to reach the point of instability under certain negative temperature gradients in the vertical direction. In this work the effect of electromagnetic fields on this type of instability is investigated, the fluid being assumed to be electrically conductive.

Definite conclusions have been arrived at through an analytical study of the behavior of perturbation quantities in the columns under consideration. After proving that neutrally stable perturbation-modes (or convection-modes) are time independent, the resulting homogeneous differential systems governing such modes are solved. Exact or approximate solution for these eigenvalue systems yield the numerical relationships between the imposed electromagnetic fields and the critical temperature gradients. It is found in most cases considered, that convection is inhibited by the electromagnetic field, but the effectiveness of the inhibition depends very markedly on the mode of convection. Microfilm $2.00; Xerox $4.40. 83 pages.

THE CREEP BUCKLING OF COLUMNS MADE OF CANVAS LAMINATE.

(L. C. Card No. Mic 59-4504)

George Albert Costello, Ph.D.
University of Illinois, 1959

Three different theoretical relations were presented for predicting the load-deflection curves for an

eccentrically-loaded column which is made of a material that creeps. Each theory was based on the assumption that the compressive isochronous stress-strain diagrams of the material could be represented by arc hyperbolic sine curves and that the stress-strain relation for each fiber of the column was the same as the compressive isochronous stress-strain diagram. The more exact theoretical load-deflection curve, referred to as the arc hyperbolic sine theory, was based on the further assumption that the column axis deforms into either a cosine curve or a segment of a circle. A less exact theoretical load-deflection curve, referred to as the modified secant formula, assumed that the stress distribution in the column is linear.

In order to check the validity of these theoretical relations, creep tests were made on 27 eccentrically-loaded columns which were made of canvas laminate. Twenty-three of these columns had rectangular cross-sections, had slenderness ratios of either 30, 50, or 70, and were subjected to initial eccentricities of either 2, 5, or 25 percent of the column depth. The remaining 4 columns were T-section columns having a slenderness ratio of 50.2 and were subjected to an initial eccentricity of 5 percent of the depth.

The difference between theory and experiment was reported in the form of plots and tables. The arc hyperbolic sine theories based on the assumption that the column deforms into a cosine curve, gave collapse loads which are always conservative and in excellent agreement with the experimental data. A theoretical collapse load could also be computed using the modified secant formula; however, the resulting load was the tangent modulus load which is independent of the initial eccentricity of the column. If the initial eccentricity of the column was less than 2 percent of the depth, the tangent modulus load was found to be in error by less than 6 percent.

The arc hyperbolic sine theory, based on the assumption that the column deforms into a segment of a circle, was used to predict the column deflection. The assumptions made in this theory should make the theoretical deflections conservative; the test data confirmed this fact. However, this theory was too conservative for columns having an initial eccentricity of 5 percent of the depth or less. For the smaller eccentricities, the modified secant formula was found to give a good estimate of the column deflection. It could also be used to predict the deflection of columns having an initial eccentricity of 25 percent of the depth if the column load was less than one-half the buckling load.

Microfilm $2.00; Xerox $3.00. 56 pages.

STRESSES IN A SPHERICAL SHELL DUE TO A UNIFORMLY DISTRIBUTED INTERNAL PRESSURE AND AN ATTACHED CYLINDRICAL NOZZLE.

(L. C. Card No. Mic 59-4507)

Le Roy Carl Eichberger, Ph.D.
University of Illinois, 1959

The equilibrium equations for the spherical and cylindrical shell were derived in terms of the displacement components of the middle surface of the shell. The analysis is based on the Kirchhoff assumption, and on small-deflection approximation.

The solution of the equation of the cylindrical shell is expressible in a closed form. The spherical-shell equations are transformed to linear algebraic equations by finite-difference approximations. The spherical-shell problem reduces to the solution of n simultaneous equations, which are easily handled by the Illiac Digital computer. The solution is given in terms of middle surface displacements u, w for each net point in the system. The stresses are quickly obtained from the displacement values by numerical differentiation.

Agreement between theory and experiment is good for the inner surface; however, for the outer surface, wide discrepancies are experienced in the vicinity of the reentrant corner.

The maximum stress concentration factor of theory agrees with experiment, with an error slightly greater than 5%.

In conclusion, theory yields a representative stress concentration factor for the problem chosen. Additional comparisons between theory and experiment should be made to confirm the analysis.

Microfilm $2.00; Xerox $3.60. 61 pages.

THE STABILITY OF A STRATIFIED FLOW.

(L. C. Card No. Mic 59-4916)

William Paul Graebel, Ph.D.
University of Michigan, 1959

The flow whose stability is studied is a flow of two stratified fluids of equal viscosity but different densities. The flow is entirely motivated by gravity and its velocity distribution is antisymmetric, with the lighter fluid flowing in a direction opposite to that of the heavier fluid, and with a point of inflection of the velocity profile at the interface. The flow takes place between two parallel planes, inclined at an angle θ with the horizontal.

The Navier-Stokes equations are linearized by the assumption of small disturbances. A stream function is then introduced to obtain two equations of the Orr-Sommerfeld type. The boundary conditions imposed include the effects of surface tension at the interface, and also allow for a displacement of the interface due to the disturbance.

Since instability is expected to occur at low Reynolds numbers when the inclination is nearly vertical, the stability equations are solved by a Taylor expansion appropriate for small Reynolds numbers. Thus singularities encountered in most stability analyses for high Reynolds numbers are not introduced.

For the case of vertical inclination it is shown that the flow is unstable at all values of the Reynolds number. The stabilizing effect of surface tension is also shown, although it can never induce complete stability. The celerity of the disturbances anticipated is small, and the displacement of the interface can be large.

For slopes other than the vertical, a critical Reynolds number exists. The critical wave number is also found, and is given in the text.

The presence of the interface is responsible for instability at low Reynolds numbers at steep slopes. However, the counterflow is shown to exert a certain stabilizing influence.

Microfilm $2.00; Xerox $3.00. 55 pages.

ON ELASTIC BUCKLING OF SYMMETRICAL ARCHES.

(L. C. Card No. Mic 59-4528)

Niels Christian Lind, Ph.D.
University of Illinois, 1959

The circumferential strain at any point and the change in curvature of the centroidal axis of a plane member of variable curvature is expressed in terms of the components of the displacement vector under the assumption of plane deformation. The most important quadratic terms in the displacement components are retained. On the basis of these quantities, an expression for the flexural strain energy, correct to the second degree, is derived. Likewise, an expression for the total strain energy that contains the most important cubic terms in the displacement components is derived.

With the aid of the derived strain-energy expressions the deformation of a two-hinged symmetrical arch with a constant cross-section, loaded at the vertex by a concentrated vertical force, is determined by the principle of minimum potential energy. The second variation of the potential energy is expressed in the canonical form in terms of definite integrals of functions of the arc length and the load. The critical load, determined as the lowest eigenvalue of this form, is found for circular, parabolic and catenary arches as a function of the ratio between the height and the span. A numerical procedure is indicated by means of which the buckling load may be determined for other shapes of arches.

Experiments on arches are reported. They show good agreement between the theoretical buckling load and the maximum load-carrying capacity of the arches. It is shown that the collapse load may be reduced considerably by the presence of asymmetrical imperfections in the geometry or in the manner of loading. It is demonstrated by an example that initial stresses in the arch may also cause a considerable reduction in load-carrying capacity.

Microfilm $2.00; Xerox $4.80. 94 pages.

CALCULATION OF STRESS CONCENTRATION FACTORS IN FILLETED MEMBERS BY THE EQUIVALENT SURFACE-SHEAR LOAD METHOD.

(L. C. Card No. Mic 59-4532)

Archie Mathews, Ph.D.
University of Illinois, 1959

In the technical literature dealing with stress concentrations little is said giving a physical explanation for the existence of the stress concentration. Furthermore no analytical solutions for some seemingly simple shaped members are given. Mathematical difficulties in satisfying the boundary conditions seem to be the major obstacle.

In some cases, such as those discussed in this thesis, it may be possible to simplify the boundary geometry somewhat by removing parts of the members. Equivalent loads which simulate the removed portions are placed on the cut sections.

It appears from the results of this thesis and previous works on the subject that the dominate stresses associated with the cut sections are the shearing stresses. This leads to the belief that a stress concentration in the vicinity of a geometrical discontinuity is the result of the lateral transfer of the load by shearing stresses around the discontinuity.

In this thesis stress concentration factors for a flat filleted bar subjected to tension, bending and shearing loads are calculated. The filleted bar is transposed into a flat bar of constant width by removing side strips of material. A load equivalent to the stress distribution along the cut sections must be applied along the corresponding boundaries of the straight bar. This equivalent load should be statically equivalent to and have a similar distribution to the stress distribution in the original member. It is assumed that normal stresses along this section can be neglected in the stress analysis. In some cases it is necessary to consider the rigid body effects of these normal stresses in maintaining static equilibrium of the straight bar. The equivalent shear load is expressed by a Fourier series and the stresses in the straight bar are found from the theory of elasticity.

The stress concentration factors found in this manner are compared with photoelastic results. Good agreement between the analytical and photoelastic results is found in most cases. However the method does not include the proximity effect of applied loads in short members. These would have to be determined from some other source and added to the analytical results of this method.

Microfilm $2.00; Xerox $3.00. 49 pages.

THEORY OF NON-HOMOGENEOUS ANISOTROPIC ELASTIC SHELLS SUBJECTED TO ARBITRARY TEMPERATURE DISTRIBUTION.

(L. C. Card No. Mic 59-4539)

Robert Earl Miller, Ph.D.
University of Illinois, 1959

This paper extends the small deflection theory of shells to include effects of anisotropy. The first part of the paper is concerned with geometry of shells, equilibrium, and strain-displacement relations.

A general expression for the strain energy of a shell is developed. The general theory is specialized for cylindrical shells, conical shells of circular cross-section, spherical shells, and axially symmetrical orthotropic shells of revolution.

As an illustration of the application of the theory, two problems of axially symmetrical orthotropic circular cylinders are analyzed; (1) an infinite cylinder with temperature varying through the thickness, (2) a semi-infinite cylinder subjected to end moments, end shears, and a temperature distribution that is constant through

the thickness and that decays exponentially in the axial direction. Numerical values of deflections and stresses are computed for the second problem for various types of orthotropy. These deflections and stresses are compared to those for the isotropic case.

Microfilm $2.00; Xerox $3.80. 69 pages.

VISCOELASTIC SHALLOW SPHERICAL SHELLS UNDER TIME-DEPENDENT LOADS.

(L. C. Card No. Mic 59-3950)

William Coe Orthwein, Ph.D.
University of Michigan, 1959

The purpose of this study is to obtain expressions for the displacement and the stress function for an unlimited shallow spherical viscoelastic shell under axisymmetric loads which may display arbitrary time dependence.

Based upon existing equations of motion for elastic shells, the viscoelastic equations of motion are determined in conjunction with the correspondence principle relating the elastic and the viscoelastic problems. The argument leading to the introduction of an Airy stress function, founded upon the neglect of the longitudinal inertia effects, is re-examined and the results restated. Having established the use of the Airy stress function, the system of two simultaneous partial differential equations is solved by resorting to operational methods employing the Laplace and Hankel transforms. The solution thus obtained applies to the case of axisymmetric loads with arbitrary time dependence. Supplementary to this, a closed form solution in terms of Kelvin functions of complex argument is presented for the steady state amplitude of the motion of a shallow spherical shell under harmonically time-dependent loads. The solution for the corresponding elastic problem may be deduced as a special case of this solution.

A graphical presentation of the results for a uniformly distributed instantaneous load over a centrally located circular area is given; in a similar manner the steady state response to a harmonically varying uniformly distributed load over a circular area concentric with the origin is shown. This presentation includes both the elastic and viscoelastic bodies.

Microfilm $2.55; Xerox $8.80. 193 pages.

THE PROPAGATION OF LONGITUDINAL WAVES IN LONG ELASTIC RODS.

(L. C. Card No. Mic 59-4748)

Carl Conrad Steyer, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Harold J. Plass, Jr.

In studying the propagation of a longitudinal stress pulse in a rod, the assumption that plane transverse sections remain plane and that the stress acts uniformly over each section results in the one-dimensional wave equation. This equation shows that stress pulses are propagated along the rod with a constant velocity without any change in shape.

Experiments show, however, that the length of the pulse continually increases and the height changes as it travels along the rod. The longitudinal contraction and expansion of a section of the rod will necessarily result in lateral expansion and contraction. This lateral motion will result in a non-uniform distribution of stress across the section of the rod, and plane transverse sections will become distorted. The effect of this lateral motion in rods becomes of importance when the pulse length is of the same order of magnitude as the diameter of the rod.

Two theories have been developed which consider the effect of this lateral motion in a rod. Love has developed a differential equation which considers the effect of lateral inertia, while Mindlin and Herrmann have developed a differential equation which includes both lateral inertia and shear corrections.

Love's equation was derived using the variational method. Davies solved this equation for a rod using certain geometric boundary conditions. One of his boundary conditions is not compatible with the problem. Davies ignored the fact that certain boundary conditions, not necessarily permitting physical interpretation, also result from the variational method. These boundary conditions must be used with the differential equation of Love in order to give correct results.

Applying the correct boundary conditions in this study, the Love equation was solved by the Laplace transform method for both a semi-infinite rod and a rod of finite length. Results were calculated for one pulse length and one diameter for purposes of comparison with experimental data obtained by Ripperger and results obtained from the solution of the Mindlin-Herrmann equation.

However, the major effort of this study was concentrated on the solution of the Mindlin-Herrmann differential equation by using finite difference equations in combination with the method of characteristics. This solution resulted in five algebraic equations at a mesh point for the five quantities, axial force, radial force, shear force, axial velocity, and radial velocity. These equations were programmed for an IBM 650 Digital Computer, and for the semi-infinite rod results were computed for six cases for comparison with experimental data obtained by Ripperger and Miklowitz.

For pulse lengths of the order of the diameter of the rod the Mindlin-Herrmann theory satisfactorily predicts the attenuation and dispersion of the pulse; but for longer pulse lengths it satisfactorily predicts only the dispersion. A significant result predicted by this theory is that the pulse peak travels at the same velocity as that given by the one-dimensional wave equation.

In the one case available for comparison of the Love theory with the Mindlin-Herrmann theory, the latter theory showed the better agreement with experimental results. Further experiments and computations are needed to verify that either of these theories satisfactorily predicts the progress of a longitudinal stress pulse travelling down a rod. Microfilm $2.00; Xerox $5.00. 100 pages.

ENGINEERING, METALLURGY

THE RELATIONSHIP BETWEEN THE PHYSICAL PROPERTIES AND MICROSTRUCTURE OF CHROMIUM-COBALT BASE ALLOYS USED IN DENTISTRY.

(L. C. Card No. Mic 59-4878)

Kamal Asgar, Ph.D.
University of Michigan, 1959

The effect of different casting conditions on the microstructure of the cast chromium-cobalt alloys was studied. In this investigation Stellite #21 was cast into a mold prepared by the Ransom and Randolph Company Investment #711. The test specimens had 1 3/8 inch length, 0.09 $\pm$ 0.01 inch diameter, and 12-24 threads at the two ends. The wax patterns were sprued in such a manner that the molten metal was fed to the mold from the remote end and the casting was gated to the atmosphere. The dimensions of the test bars as well as the manner of spruing them in this study were patterned after the proposed American Dental Association specification for dental chromium-cobalt base alloys.

Over 100 castings were made under different casting conditions, such as varying metal temperatures, varying mold temperatures, heat treating the cast pieces, and changing the length of the test specimens. After being polished, the cast pieces were etched electrolytically using 2 per cent chromic acid solution as an electrolyte. The microstructure of the alloy under consideration represented four distinct types: (1) carbides in the form of grain boundaries and continuous in nature, (2) carbides that were spherical and discontinuous, like islands, (3) presence of dark eutectoid areas close to and along the grain boundaries, and (4) a larger percentage of these eutectoid areas, which were lamellar in nature. Also the physical properties of cast pieces, including ultimate tensile strength, 0.1 per cent and 0.2 per cent yield strengths, modulus of elasticity, and the elongation of the test specimens, were obtained and compared with their microstructures. The relationship between the microstructure and physical properties was established.

It was observed that the presence or absence of any one of the four arrangements in the microstructure had a definite effect on the physical properties of the alloy. Under the normal dental casting conditions it was found that the ultimate tensile strength of Stellite #21 was 100,000 lbs./sq.in. with standard deviation of 7,000 lbs./sq.in.; the 0.1 per cent and the 0.2 per cent yield strengths were 76,000 lbs./sq.in. with standard deviation of 2,300 lbs./sq.in., and 81,000 lbs./sq.in. with standard deviation of 3,000 lbs./sq.in., respectively; the modulus of elasticity was 34×10^6 lbs./sq.in. with standard deviation of 1.5×10^6 lbs./sq.in., and average of elongation was 4 per cent. It was observed also that the higher the metal casting temperature, the more inferior was the casting surface, but such cast pieces possessed higher per cent of elongation without a considerable change in any other physical properties. Naturally, such castings did have different microstructures.

After being polished and etched, the cast cobalt base alloys were subjected to a bend test. Using this test, an examination of microstructure under varying stress was accomplished. In this way, a comparison was made of the relative ductility of the matrix material and different types of carbide phases present in the cast structure. It was found that the presence of microporosities in the cast pieces was the main source of failure, and the cracks were initiated along the microporosities. If the cast pieces, however, were sound and free from microporosities, the dark eutectoid areas present close to grain boundaries served to initiate the cracks due to their low ductility. If the cast pieces were relatively free from the dark eutectoid areas close to the convex side of the bent specimen, where the stress was highest, then the crack was initiated along the grain boundary. These points are illustrated by means of a series of photomicrographs.

A few specimens were prepared for x-ray diffraction studies. It was found that an alloy may crystallize entirely in the cubic system, or it may crystallize partially in the cubic system and partially in hexagonal structure. The composition of the cobalt base alloys as well as the casting conditions determine the type of the structure of an alloy.

Microfilm $2.35; Xerox $8.20. 179 pages.

SOME THERMODYNAMIC PROPERTIES OR URANIUM-BISMUTH ALLOYS.

(L. C. Card No. Mic 59-4899)

Andrew Cosgarea, Jr., Ph.D.
University of Michigan, 1959

Thermodynamic properties of uranium-bismuth alloys were determined by measuring the vapor pressure of bismuth in equilibrium with the condensed phase. Classical methods based on the rate of sublimation, rate of evaporation, or rate of effusion could not be used since each method requires an accurate knowledge of the molecular weight of the vapor. The molecular weight of bismuth vapor is not accurately known, but the presence of Bi and Bi_2 species has been established.

An optical absorption technique was used to determine the concentration of each species independently. Briefly, this method consists of measuring concentrations in a vapor by the quantity of light absorbed at certain characteristic frequencies by the species in the vapor. Monatomic bismuth was detected by observing the absorption of radiation at 3067Å by ground-state electrons in the free atom. The diatomic population was measured by observing the absorption of energy by the electronic band head at 2731Å. The amount of each species present, which is related to the pressure, was determined by measuring the diminution of intensity at 3067 and 2731Å. The amount of radiation absorbed was found to be dependent on the thickness of the vapor space and the concentration of the bismuth vapor.

The thermodynamic activity of bismuth was measured at temperatures from 1350 to 1575°F in the regions: U_3Bi_4 + UBi_2, UBi_2 + liquid, and the one-phase, liquid region. In order to obtain measurable quantities in the regions UBi + uranium and UBi + U_3Bi_4 it was necessary to work at temperatures from 1500 to 1850°F. From a measure of the activity of bismuth, the activity of uranium was calculated for the entire system. At a representative temperature of 1916°R the activity of uranium in two-phase regions was calculated as: (1) 1.0 (reference state), in the uranium + UBi region; (2) 2.97×10^{-1}, U_3Bi_4 + UBi

region; (3) 1.45 x 10^{-2}, UBi_2 + U_3Bi_4 region; and (4) 4.27 x 10^{-3}, UBi_2 + liquid region. The liquid uranium-bismuth alloys were found not to be regular solutions. The Henry's law parameter (3.49 x 10^{-3} at 1916°R) was found to be valid for uranium concentrations of less than 2 mole percent uranium. From a complete knowledge of the activities of uranium and bismuth in the system the partial molar quantities and integral molar quantities were calculated at five temperatures: 1832, 1873, 1916, 1961 and 2008°R.

The optical absorption measurements yielded: (1) thermodynamic properties for uranium-bismuth alloys, (2) a correlation for adsorbed bismuth atoms on quartz as a function of pressure, (3) the heat of vaporization of Bi (37.3 kcal per gram atom), the heat of vaporization of Bi_2 (39.5 kcal per gram mole), and (4) the heat of dissociation of the Bi_2 molecule (35.0 kcal per gram mole).

Microfilm $2.00; Xerox $4.60. 87 pages.

ORDERING AND CREEP PROPERTIES OF NI-CR-AL-ALLOYS.

(L. C. Card No. Mic 59-4921)

Charles Milles Hammond, Ph.D.
University of Michigan, 1959

Many important heat and corrosion resistant alloys are based upon the nickel-chromium-aluminum system. Because of the complexity of these industrial alloys, caused by many other added elements, the essential features of the simple nickel-chromium-aluminum system, which contribute to strength at elevated temperatures, have been obscure. Previous investigators have indicated that two structural transformations may be of importance:

1. Ordering of the $Ni_3Cr(\gamma)$ phase - (controversial)
2. Controlled precipitation of the $Ni_3Al(\gamma')$ phase.

The objective of this thesis was to investigate the controversial order-disorder transformation as well as γ' precipitation in the Ni-Cr-Al system and to correlate creep properties with the structural transformations disclosed. The alloy compositions selected for this research extended from the Ni_3Cr to Ni_3Al. The existence of ordering was studied by elevated and ambient temperature X-ray diffraction. Optical and electron microscopy were used to ascertain the phases present during X-ray diffraction and creep testing.

The data of this investigation indicate that no long range ordering exists in the γ solid solution of Ni-Cr-Al alloys. The superlattice indications from ambient temperature X-ray patterns of solid specimens, quenched from the single phase γ field to room temperature, results from γ' precipitation during quenching. Therefore, the predominant structural change in Ni-Cr-Al alloys is precipitation hardening by the ordered γ' phase.

Precipitation of γ' results in marked strengthening of simple Ni-Cr-Al alloys at 750°C (1382°F). The yield strength of precipitation hardened alloys is five to six times greater than single phase alloys. Percent elongation is decreased 40-fold as a result of γ' precipitation. The creep strength (i.e., the stress required to produce a creep rate of 0.001 percent/hour) is increased five to six fold by γ' precipitation. Changes in the γ' dispersion, by a factor of two in size and mean free path, did not significantly affect the creep strength. The results agree with recent theoretical predictions of the effect of dispersion hardening upon creep properties.

Microfilm $2.00; Xerox $5.20. 102 pages.

THERMODYNAMIC STUDIES ON LIQUID IRON ALLOYS CONTAINING COPPER.

(L. C. Card No. Mic 59-5129)

George Simkovich, Ph.D.
The Pennsylvania State University, 1959

Several problems related to the presence of copper in liquid iron alloys were investigated.

Slags having various active constituents were brought into contact with carbon-saturated iron alloys at 1625° C. It was found that the solubility of copper in calcium sulfide slags increased when sulfur was initially present in the liquid iron alloys. Calcium oxide slags had a small affinity for copper; this affinity increased when sulfur was initially present in the liquid iron alloy. It appears that slags whose cations have a strong affinity for sulfur will extract more copper from liquid iron alloys when sulfur is initially present in the liquid iron alloy. Conversely de-copperization by slags having cations that possess a low affinity for sulfur is not affected by the initial presence or absence of sulfur in the melt.

Manganese (II) sulfate slags were found to lower the copper contents of liquid iron alloys by about 0.10 per cent copper. The amount of calcium fluoride in the slag, initial copper and sulfur contents of the iron alloys, and temperatures between 1400° and 1600° C did not materially affect de-copperization by these slags.

The effect of copper upon the Henrian activity coefficient of sulfur was studied at 1625° C by utilizing hydrogen-hydrogen sulfide atmospheres. It was shown that copper slightly decreases this activity coefficient.

A consideration of various energy terms indicates that the effect that alloying elements have upon the Henrian activity coefficient of sulfur is related to the difference between the free energies of formation of the alloy sulfides and iron (II) sulfide. Based upon this consideration most of the alloying elements present in steels will aid de-sulfurization by increasing the Henrian activity coefficient of sulfur.

Solubilities of carbon in carbon-saturated liquid iron melts were studied as a function of copper contents at 1300° and 1490° C. Copper decreases the solubility of carbon at these temperatures. Raoultian activity coefficients of carbon were calculated as a function of copper contents and were found to increase with increased copper contents. Partial molar heats of solution of carbon were calculated and were found to decrease slightly with increased copper contents.

Microfilm $2.00; Xerox $5.80. 118 pages.

ALLOY SOLIDIFICATION AND SEGREGATION AT A ROTATING-DISK INTERFACE.

(L. C. Card No. Mic 59-4178)

George Francis Sommer, Ph.D.
Purdue University, 1959

Major Professor: Dr. R. Schuhmann, Jr.

Theoretical analyses have been published for predicting alloy segregation during solidification at a plane, rotating-disk interface. These analyses are based on steady-state solidification in which the mass flow rate is controlled by diffusion across a boundary layer in the liquid just ahead of the solid-liquid interface. Experiments were conducted for the purpose of verifying the theoretical work.

An apparatus was constructed for growing rotating, polycrystalline ingots from an induction-heated melt. Provision was made for water cooling one end of the rotating ingot. Experiments were conducted with growth rates from 0.001 to 0.010 cm/sec and with rotation speeds up to approximately 1000 rpm.

The following alloy systems were used: copper in aluminum, tin in lead, and silicon, lead and sulfur in copper. The melts varied in composition from 0.03 to 5.6 per cent by weight. Most of the ingots grown were between one and two centimeters in diameter.

The amount of segregation is reported as the ratio between solute in the solid and solute in the bulk liquid. Segregation was found to increase with increased rotation rate and to decrease with increased growth rate about as predicted by theory. The solute concentration in the solid was always greater than predicted by the theoretical equations.

Segregation of solute along grain and sub-brain boundaries is believed to be the main reason for the observed solute concentrations being higher than calculated.

Horizontal bands or striations were observed along the length of sectioned ingots. These are assumed to be evidence of variation in composition. Observation of ingots during growth indicates that, at least under some of the growth conditions, striations were caused by variation in growth rate due to surface tension forces.

Microfilm $2.00; Xerox $5.80. 120 pages.

KINETICS OF THE PLATINUM-CATALYZED HYDROGEN REDUCTION OF AQUEOUS COBALT SULFATE-AMMONIUM ACETATE SOLUTIONS.

(L. C. Card No. Mic 59-4863)

Ray Ted Wimber, Ph.D.
University of Utah, 1959

Chairman: Milton E. Wadsworth

Part I of this thesis is an account of an investigation of the surface chemistry and aqueous solution chemistry of the ammonical cobaltous sulfate system involved in the commercial hydrogen reduction of cobalt. Reduction studies were carried out at moderately elevated temperatures in clear quartz capillary tubes so that the bluish-green solid and the associated solution could be observed as metallic cobalt precipitated. Additional information regarding the nature of the solid and associated solution, as well as the reduction mechanism, was obtained from chemical analysis and x-ray diffraction patterns of the solid, from pH-potentiometric titrations, and from analysis of the clear solution obtained by filtration at 95°C.

After it was discovered that ammonium acetate-cobalt sulfate solutions containing hydroquinone could be reduced by hydrogen to produce cobalt metal, a preliminary investigation of the chemistry of this system was carried out. An account of the results of this investigation is presented as Part II of this thesis. The presence of the $Co(Ac)_2 4H_2O$ complex in solutions heated to 85°C was indicated by absorption spectra and results of pH studies. At temperatures greater than 165°C a light pink precipitate existed in equilibrium with the solutions. This precipitate was found to be $Co(Ac)_2 \cdot 4H_2O$ from consideration of its x-ray diffraction pattern.

Chloroplatinic acid was found to catalyze the hydrogen reduction of ammonium acetate-cobalt sulfate solutions. Part III of this thesis is an account of the investigation of the kinetics of the reduction of this system. Cobalt sulfate solutions containing ammonium acetate and chloroplatinic acid were reduced by hydrogen in a pyrex-glass lined autoclave in the temperature range of 170° to 232°C and hydrogen partial pressure range of 115 to 830 psia. The reduction rate was directly proportional to the hydrogen partial pressure and surface area of the pyrex glass and was independent of the quantity of chloroplatinic acid added initially. Experiments involving the variation of the relative concentration of ammonium acetate indicated that the reducible cobalt complex was the diacetate complex of cobalt, $Co(Ac)_2 4H_2O$, which was in solubility equilibrium with a pink precipitate, $Co(Ac)_2 \cdot 4H_2O$. In accordance with the experimental findings a mechanism was proposed in which hydrogen adsorbed on a surface site and reacted slowly with a cobalt complex in the solution phase to produce an intermediate which decomposed to yield cobalt metal. The cobalt sulfate-ammonia and cobalt sulfate-ammonium acetate reduction systems were compared and were found to be reduced with about equal ease. Type 316 stainless steel and Carpenter 20 were shown to be catalysts for the hydrogen reduction of the two systems, respectively. Microfilm $2.00; Xerox $4.20. 80 pages.

A CRITICAL EVALUATION OF STREAMING POTENTIAL MEASUREMENTS.

(L. C. Card No. Mic 59-4099)

Gordon L. Zucker, Eng.Sc.D.
Columbia University, 1959

Streaming potential measurements are subject to an important source of error; an error which may exceed the magnitude of the true streaming potential. A potential difference can arise when the cell electrodes alone undergo motion with respect to the electrolyte and is associated with the polarizability of the electrode material(s). A reversible electrode in a flow system measured against an electrode in a quiescent compartment has its potential changed by electrolyte flow; but two electrodes identical in geometry as well as in reversible e.m.f. exhibit no potential differences upon flow of electrolyte.

Streaming potential literature is scrutinized with respect to the interpretation placed upon zeta potential measurements and with respect to the validity of the data taking into consideration the electrode flow potentials. Measurements with proven reversible electrodes are made on the minerals Barite and Quartz. The results on Barite differ from previously recorded zeta potential data, but factors other than electrode flow potentials may be involved. The results with Quartz differ significantly from those of other investigators, indicating that interpretations drawn from the earlier results are invalid.

Microfilm $2.05; Xerox $7.40. 156 pages.

RUBENS AND ANCIENT ART.

(L. C. Card No. Mic 59-4960)

Victor Hugo Miesel, Ph.D.
University of Michigan, 1959

An important factor in the painting of Rubens was his utilization of earlier art. In addition to the works of Titian, Michelangelo and Giulio Romano, the art of antiquity played a significant role in his painting. The purpose of this study is to investigate the relationship of Rubens to ancient art in order to determine its extent and character. Because of the wide scope that this theme possesses the analysis is limited to a consideration of only two aspects of this problem, the formal and the historiographical.

Part I of the study attempts to determine what Rubens could have known of ancient art and to uncover specifically which works the artist might have used for compositional and figure motifs. The artist is shown to have had the opportunity to see almost every major work of antiquity extant in the seventeenth century. To minimize the dangers of discovering too many accidental and secondary relationships between the artist's painting and ancient work, original drawings by Rubens, as well as related shop drawings, that were clearly taken from antiquity, are used as far as possible for points of departure. Rubens adapted not only ancient statuary but also numerous reliefs to his artistic needs, and on one occasion at least appears to have used a composition based on a Roman fresco.

Part II is a historiographical analysis of significant speculation and research, from Rubens' day up until the present, concerning the artist's relationship to antiquity. Basically, four institutions of critical thought about the problem can be distinguished. The first, engendered by the theories of the French Academy, sharply contrasted the artist and antiquity, provoking a struggle that has been called that of the rubénistes versus the poussinistes. The second was shaped primarily by Romantic and historical thought during the first half of the nineteenth century. It interpreted Rubens as a synthesizer of the disparate tendencies resident at the heart of Western culture, a synthesizer of Classical and Romantic, ancient and modern attitudes, themes and forms. The third, in partial reaction to the former, initiated investigations during the latter half of the nineteenth century of a more objective and less metaphysical character. This attitude is termed positivistic, even though one of its chief exponents, Jacob Burckhardt, was as much concerned with the subjective as with the objective aspects of the problem. The culminating institution of criticism, typified by the Warburg Institute, emerged during the twentieth century, and embodied not only a positivistic devotion to fact but a deeply humanistic appreciation of the cultural value of ancient art as well.

Two general conclusions can be drawn from this study. 1) Rubens' debt to ancient art was great. However, he never descended to simple imitation but throughout his entire career handled his prototypes with an originality and freedom that varied subtly in accordance with his own stylistic development. 2) Thought concerning Rubens' connections with ancient art did not always recognize the above points. Nonetheless, a continued interest was shown in the problem for over three hundred and fifty years, an interest which, while maturing with time, reflected significant historical developments to such a degree that the theme became more than a topic of research, it became a vital cultural issue.

Microfilm $4.75; Xerox $15.80. 370 pages.

THE INFLUENCE OF MONETARY VALUE ATTACHMENTS TO WORKS OF ART ON THE RESPONSES OF RURAL AND URBAN CHILDREN AND ADULTS.

(L. C. Card No. Mic 59-5125)

Phil Hermann Rueschhoff, Ed.D.
The Pennsylvania State University, 1959

This investigation was concerned with the influences that monetary value attachments to works of art might have upon the responses of rural-urban children and adults. The investigation involved two hundred and forty individual cases. Of the two hundred and forty cases, one hundred and twenty were from a rural population while the remaining one hundred and twenty were from an urban population. Within this population, there were four specific age groups, eight control groups, and eight experimental groups. Fifteen individual cases constituted each control and each experimental group. Each case was selected at random from either a rural or an urban population. The four age groups represented in the investigation were: the six and a half to seven and a half year olds; the nine and a half to ten and a half year olds; the twelve and a half to thirteen and a half year olds; and, the adults or over twenty-one year old age group.

The testing instrument used to determine the influences of monetary value attachments to works of art was selected according to the art preference of children. Thirty-five works of art constituted the testing instrument. Research techniques for using the testing instrument were established prior to the time that the data was collected.

For purposes of statistical analyses, the responses to each work of art in the testing instrument were recorded in quantitative numerical terms. The cases in the control and experimental groups were tested individually, simultaneously, alternatively, and consecutively throughout the investigation. In the experimental design, the same number of cases, selected at random, appeared in all cells. For this reason, a triple classification analysis of variance was used to analyze the data. The analysis revealed that the influences of monetary value attachments to works of art approached significance at the 5 per cent level. According to the t test of significance, the influence variance

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approached significance at the 5 per cent level in the nine and a half to ten and a half year old age group. The age variance in the investigation was highly significant while the rural urban variance was not.

In specific art preference categories, the results of the chi square analysis indicated that identical preferences would have been expressed for specific works of art with or without monetary value attachments. However, the obtained value of chi square for the preference of abstract works of art did show a significant influence of monetary value attachments. The mean and standard deviation indicated that the I.Q.'s were not a determining factor in the investigation.

Since the population sampled at random was unfamiliar with works of art, related studies by Ansbacher, Bruner and Postman, Thorndike, and Tolman substantiated the findings in this investigation.

Microfilm $2.00; Xerox $6.60. 139 pages.

A COMMUNITY DEVELOPMENT APPROACH TO REGIONAL PLANNING IN WESTERN PAKISTAN.

(L. C. Card No. Mic 59-3248)

Khalid Shibli, Ph.D.
Columbia University, 1958

The physical structure of communities everywhere is shaped and controlled by the economic, social, and political forces of a nation, within its geographic conditions and technological limitations. The question asked at the beginning of this dissertation was;

> Can a nation like Pakistan directly apply the Western theory of Physical planning effectively?

Since West Pakistan is primarily an agricultural region where traditionally the life and activities of the people are centered at the village level, the answer to the above is no. Successful regional planning will only be achieved by first initiating a community development approach, and then coordinating the village and regional planning programs within the broad framework of a permissive and amply-supporting national policy.

Development of social, economic, political, and architectural theories in the West was traced and the results integrated into a broad framework of city and regional development within an overall history of Western civilization. This was then compared with the present situation in Pakistan, and it was found that this under-developed country cannot and should not adopt any of the various physical planning concepts would be necessary in light of Pakistan's culture, resources, needs, goals, religion, and in fact the whole social texture of her society.

What, then, is the most logical and sound approach to regional planning in Pakistan?

It is the opinion of the author that a community development approach must be undertaken in order to conduct effective regional planning. How can this be achieved?

First, through recognizing the significance of the village elders, understanding their importance and providing for their participation in the effectuation and administration of the plan.

By ageless tradition, both family and religious, these village elders have gained the unquestioned respect of their fellow citizens as a stabilizing and guiding influence over the everyday life of the village. Their status should therefore be provided for in any proposals which might affect the life and habits of the villagers and their function should be utilized in effectuating and administering such proposals.

It is important then that the village elders be thought of as planning administrators who, although not professional planners, will be in a position to aid in the effectuation of regional master plans or physical improvement programs at the village level.

Second, successful regional planning depends to a great extent on improving the physical characteristics and environment of the village. Greater importance will have to be given to improved village design in order to make the Mosque, with its adjacent school and plaza, the real heart of the community - physically, socially, and culturally.

The conclusion of the dissertation is this: The only logical way to approach regional planning in Western Pakistan is through a locally-conceived and properly effectuated development program, starting at the village level and progressing in gradual steps to the coordinated planning of groups of rural communities until whole regional areas are encompassed.

Microfilm $5.60; Xerox $19.60. 440 pages.

FOOD TECHNOLOGY

MATHEMATICAL TECHNIQUES FOR EVALUATING LABOR UTILIZATION IN DAIRY PLANT OPERATIONS.

(L. C. Card No. Mic 59-4687)

Max Edwin Gregory, Ph.D.
North Carolina State College, 1959

Supervisor: William Milner Roberts

Work sampling was used as a time study technique to secure labor information about a commercial dairy plant operation. The data were used in allocating labor used to individual products in a commercial dairy plant. Statistical techniques and mathematical equations were used to develop the labor data into prediction equations that were established for the individual products. An illustration was given demonstrating how the equations were used as a management control of labor used. An evaluation was made of some hypothetical cases of labor organization in operating a dairy plant through the use of the prediction equations.

The procedure to establish individual product labor

needs involved a preliminary study, and a 36 day labor utilization study at a commercial plant. In the pilot study the feasibility of such a study was tested, and also the usefulness of the technique to be employed. Work sampling was used as the labor utilization tool in the study. The labor information acquired from the commercial study was classed into variable and fixed times. The labor data were collected in such a fashion that the labor requirements could be tied directly to individual products. After the data had been treated statistically, mathematical prediction equations were developed on the individual products to express a volume and labor relationship.

The data from the commercial plant study were treated statistically. Confidence limits were established upon the fixed times. An analysis of covariance was carried out on each of the individual products, testing both the variable and fixed times for differences by days, differences by weeks, and for significance of regression coefficients. A regression equation was computed for each classification, and the standard error of "b" was given.

The results from the commercial plant study showed that only a few products exhibited significant day to day differences in labor used, whereas weekly differences showed up in about one-third of the products. Regression coefficients were highly significant in most of the products indicating that a volume change was reflected in total labor used.

The equations were used to establish a management control on the labor used in the commercial operation. Confidence limits were given on the established curves; total processing variable time, total processing fixed time, total processing delay time, total shipping time, total cold storage time, total shipping-cold storage delay time, and total plant time per unit. The confidence limits give one an idea of the amount of variability to expect in an actual commercial operation; whereas hypothetical plant studies have no estimation of such.

The importance of volume in an actual operating dairy plant in affecting a relatively low labor requirement per unit was illustrated. The results from the volume-labor analysis was in agreement with hypothetical plant studies concerning economies of scale that are found in the literature, i.e., as the volume increases within an operation, the labor used per unit decreases.

The use of the equations was illustrated in some plant situations to show how one might use the equations for determining labor needs in planning a dairy operation.

Microfilm $2.00; Xerox $5.20. 104 pages.

THE EFFECT OF DIETARY PROTEIN AND FAT ON CHANGES OF CHOLESTEROL LEVELS IN CHICKS.

(L. C. Card No. Mic 59-4525)

Mohan Gundo Kokatnur, Ph.D.
University of Illinois, 1959

Survey studies of the American diet as compared to other population groups in the world have indicted dietary fat as a prime reason for elevated serum cholesterol levels in Americans. However, it is significant that changes in other nutrients such as protein, type of fat and carbohydrate have been shown to affect serum cholesterol level. An over-emphasis on dietary fat seems to have prevented consideration of other important dietary components such as protein. In the present study a series of experiments in which one of the following became a variable was designed. (1) the dietary protein level, (2) the dietary fat level, (3) the energy to protein E/P ratio of the diet and (4) the type of dietary fat. The design of the experiments and the treatment diets was such that the effect of a particular nutrient on cholesterol levels could be evaluated from the experiments. The chicks were fed ad libitum or on the basis of an Equalized Feed Intake method. The diets contained purified ingredients and were supplemented with all the amino acids, minerals and vitamins known to be required for optimum growth in chicks.

After four weeks the chicks were kept without food for 24 hours and 5-6 ml. of blood obtained from three "median" weight chicks by heart puncture. The serum prepared from blood samples was stored at -10 C. until ready for analysis. The determination of total cholesterol in serum, carcass and aorta was done by the standard Schoenheimer and Sperry method.

The results indicated that dietary protein had a profound influence on serum and carcass cholesterol levels in chicks. An inverse relationship seemed to exist between serum and carcass cholesterol levels and the actual intake of protein. The largest serum cholesterol value was noted in chicks which had consumed the least amount of protein. The regression effect of dietary protein on serum and carcass cholesterol values was observed regardless of the amount and type of fat in the diet. A high dietary fat level did not increase serum cholesterol levels in mature chicks unless the protein in the diet was at a subsequent level. With adequate dietary protein the increment in fat level showed a regression effect on serum cholesterol levels. The effect of the dietary fat level on carcass cholesterol values was dependent upon the type of fat. With "hard" fat in the diet carcass cholesterol values increased with increasing levels of fat. When "soft" fat was used in the diet the carcass cholesterol values decreased with increasing level of fat. The energy to protein or E/P ratio of the diet had a direct relationship to serum and carcass cholesterol levels. The lower the E/P ratio the lower were the serum and carcass cholesterol levels. This effect was observed regardless of the amount and type of dietary fat. A similar lowering effect on carcass fat and aorta lipid was noted with diets of low E/P ratio. At any particular E/P ratio of the diet the presence of a hard fat such as "lard" gave higher serum cholesterol values than a soft fat such as "corn oil". This effect was pronounced at a high E/P ratio of the diet. The differences in serum cholesterol values due to type of dietary fat were insignificant at a low E/P ratio.

Thus the level of dietary protein and the E/P ratio of the diet seemed to play an important role in cholesterol metabolism in chicks.

Microfilm $2.00; Xerox $4.60. 87 pages.

A STUDY OF THE POSSIBILITIES OF PEATLAND RECLAMATION IN IRELAND AND A SUGGESTED PLAN FOR ITS IMPLEMENTATION.

(L. C. Card No. Mic 59-4903)

William Emin Dooley, Ph.D.
University of Michigan, 1959

Although peat bogs in Ireland have been used for centuries to provide cheap fuel for domestic heating and cooking, the recent development of peat-burning generators has brought about large-scale removal of peat from many of the larger bogs. The question arises, What is to become of over 440,000 acres of bog after the peat has been removed for commercial use? Could this land, as well as nearly one million acres of uncut bog, be reclaimed for forestry and/or agriculture? It is the purpose of this study to summarize the knowledge of peatland reclamation, to investigate the possibilities of reclamation, and to suggest a plan for its implementation in Ireland.

Data for this study were obtained by two methods: first, library research in the United States and Ireland furnished historical descriptions of peat bogs and of the work carried out by man in attempts to drain, cut, and reclaim small areas; second, information on current progress was obtained through personal interviews and field investigations of many great bogs in Ireland.

A brief physical survey of Ireland is presented, followed by a discussion of the classification of bogs, and their formation and distribution. Past and present uses of bogs are discussed under three headings---the production of peat moss and fuel, experiments in afforestation, and experiments in agriculture. From the results of the experiments, it is concluded that reclamation is definitely feasible. It is further concluded that peatland reclamation should be encouraged at this time in preference to improvement of mineral soils for the following reasons. (1) Many small farms in central Ireland need to be enlarged to be economic; the addition of reclaimed bog would accomplish this. (2) In western Ireland bogland is the only soil resource available. The carrying capacity of the land there is so low that many families are on relief. Improvement of bogs would alleviate the situation. (3) When fuel-winning operations are completed on many of the larger bogs, the land will already have been leveled and drained. Reclamation can follow immediately at a great savings in cost. However, abandoning the bogs would result in their reverting to waste land.

In order for reclamation to be carried out successfully, planning will be necessary. The history of development of the present peat agency (Bord na Mona) is included to show that, besides owning thousands of acres of bog, the board has the experience, facilities, and the statutory powers necessary to act as a co-ordinating agency for planning reclamation.

Planning should include (1) providing detailed information on bogs, with recommendations as to suitable uses, (2) promoting reclamation through public education, (3) determining whether prospective uses and/or users are satisfactory, and (4) aiding actual reclamation by giving advice, training workers, and providing specialized equipment.

Finally, suggestions are made for the use of reclaimed bog, including the vertical integration of farming and processing industries such as canning and freezing, the extension of cattle grazing on bog, and the promotion of forest development. It is concluded that integrated reclamation directed by Bord no Mona would increase the economic well-being of the people directly associated with bogs and also raise the general economic level of Ireland.

Microfilm $2.15; Xerox $7.60. 161 pages.

SETTLEMENT AND LAND USE IN TUSCARAWAS, HARRISON AND CARROLL COUNTIES, OHIO.

(L. C. Card No. Mic 59-4904)

Arthur David Earick, Ph.D.
University of Michigan, 1959

The primary objective of this thesis is to trace the man-land relationship that has existed in Tuscarawas, Harrison and Carroll Counties in Ohio from the late Indian period to the present. The factors that influenced population movements and land use changes are examined along with the changing patterns of settlement and land use. These factors are grouped into four general classes: (1) the production capabilities of the land and methods of land use; (2) the occupance and economic development of other areas within the United States; (3) the changing routes and modes of transportation; and (4) the changing technology that resulted in increased industrial and urban growth and a highly mechanized type of agriculture.

In Part I, population trends are traced from the Indian era to 1930. Routes of westward migration are examined in terms of location of the thesis area. The effects of the Ohio Canal and railroads are noted. Contrasts of rural and urban growth are shown.

Patterns and methods of land use to 1930 are examined in Part II. The character and influence of Indian and pioneer agriculture are shown. The role of the Ohio Canal in expanding agriculture is outlined. Three factors are discussed as influencing the deterioration of the rural economy that began about 1850: (1) environmental features, (2) land management and land use, (3) outside features (e.g., low-cost, productive lands of the western plains and industrialization).

Resource renewal and present land use is examined in Part III. Rehabilitation of the human resource is discussed first as a preliminary necessity for renewal of the natural resources. Flood control, water conservation, soil erosion and depletion, strip mine reclamation, reforestation and recreation are discussed, first as problems and then in

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terms of actions being taken to eliminate the problems. Land use trends are noted. Present land use is discussed on the basis of (1) its character influenced by landscape types and (2) topical groupings (e.g., agriculture, woodlands, spoils bank utilization and recreation).

The study indicates that a reciprocal relationship exists between man and the land. In Tuscarawas, Harrison and Carroll Counties man entered an area of hilly, forest-covered land. The forest was removed, and land uses not suited to the topographic character were introduced. Soil deterioration soon began. It was accompanied by a similar deterioration in the rural economy. The rehabilitation measures begun in the 1930's have brought the area's rural economy well along towards recovery, but these measures should be continued or emphasized still more in order that the fullest economic potential be attained.

The primary conclusion drawn from this study is that the level of an area's economy is largely dependent on the way man uses its natural, cultural and spatial resources. A secondary conclusion is that man can be the most important resource of any area.

Microfilm $2.20; Xerox $7.80. 168 pages.

CHANGING PATTERNS OF LAND UTILIZATION WITHIN THE SALT RIVER VALLEY OF ARIZONA.

(L. C. Card No. Mic 59-4908)

William James Frazer, Ph.D.
University of Michigan, 1959

The purpose of this dissertation is to describe the land use in an area based on the control of a limited natural resource—water. A historical approach has been necessary to evaluate the factors which have provided a foundation for the present pattern of land utilization. The changes made by man during three periods of time have been described to the extent necessary for an understanding of present land use and future trends.

The Salt River Valley is one of the few areas of the arid Southwest endowed with a permanent water supply. Modern settlement was preceded by a highly advanced Indian culture based on a well-developed irrigation system utilizing the seasonal availability of waters from the Salt and Verde rivers. Early white settlement extended the canal network left by this extinct Indian civilization. Full utilization of the valley's potential did not occur until after the passage of the National Reclamation Act, which provided funds for the construction of storage reservoirs. Although the valley is handicapped by a fluctuating supply of surface water and is forced to rely heavily on underground resources, firmly established water rights have insured equitable control of available water resources.

The major factor causing land-use change has been the steadily increasing costs of operation. Other contributing forces are the high fixed costs in the agricultural system, distance from major markets and sources of supply, and increasing competition from nonagricultural land uses. They have forced complete utilization of the water supply and land use directed toward those types which yield the highest possible cash returns. An agricultural pattern of specialty crops such as cotton, citrus, vegetables, and cattle has resulted.

Recent changes in land-use patterns have been caused primarily by a rapid growth of population in the valley. The desire of the public for the "Western" style of living, afforded by the climate and the virtually unlimited land of the Southwest, has made this and other sections of the West desirable sites for living and working. The rapidly increasing population has in turn provided a significant local market which had been lacking in the past.

The pattern of land utilization is the present aspect of a constantly changing process. It is characterized by a rapid increase in nonagricultural land use of two general classes: expanding population has required an increasing amount of agricultural land for urban purposes; and industrial, commercial, and recreational types of land use have developed. Certain specialized industries which can prosper in spite of limited water supply, distance from major markets, and lack of natural resources, have developed to serve the national market.

Future growth in the salt River Valley will be limited by available water supplies. To make this growth orderly and substantial, a coordination of aims and policies and an expanded program of research into interconnected activities are needed. The amount of land devoted to urban purposes does now and in the future will drastically affect other types of land utilization. An increasing local market will place greater emphasis on food crops and diminish the importance of specialty crops and will require a greater number of services. The natural environment offers possibilities of a greatly expanded recreation and tourist industry. A limited amount of additional industrial development can occur from utilization of a few other natural resources. Future industrial expansion, however, seems limited to those undertakings which service everyday needs of an increasing population or which represent such high degrees of specialization that the factors of operating costs and distance from major markets are unimportant in their success.

Microfilm $5.00; Xerox $16.60. 390 pages.

AN ECOLOGICAL STUDY OF TOTAL MORTALITY AMONG GUATEMALAN PRE-SCHOOL CHILDREN, WITH SPECIAL EMPHASIS ON PROTEIN MALNUTRITION AND KWASHIORKOR.

(L. C. Card No. Mic 59-4572)

Herbert Slutsky, Ph.D.
University of Illinois, 1959

In protein malnutrition and kwashiorkor, the world is faced with a most serious and difficult public health problem. Although global in extent, its intensity varies regionally. The geographical pattern indicates that most malnutrition occurs in the technically under-developed countries of the world.

Medical geography studies the interrelations of the geographic elements that may be involved in bringing about a particular disease. From the results it attempts to arrive at practical solutions for the amelioration of illness. It follows from this definition that protein malnutrition and kwashiorkor constitute a medical geographical problem. Although the cause of these diseases is clear, the problem for the medical geographer is to explain why there are more of these conditions in one region than in another.

An ecological investigation of protein malnutrition and kwashiorkor was made in Guatemala using geographic techniques. The first step, the exploratory phase, proved that there was a geographical distribution of mortality. The genetic phase, or second step, required that certain surveys be carried out. The remedial, or third phase, served two purposes; first, it demonstrated the interrelation between nutrition and environmental factors and second, it allowed the formulation of a set of recommendations for the amelioration of illness in Guatemala.

To find out why the geographical pattern existed, a field study to explore the geographic variation in malnutrition was undertaken by a research team of nine persons. Ten villages and towns were randomly selected, five of which were located in areas of high mortality and five in areas of low mortality. A physical examination was performed on 1193 Indian and Ladino pre-school children; 814 of whom were females. The examination included a search for signs of malnutrition, the clinical diagnosis of specific diseases, the measurement of height and weight, and an appraisal of the general nutritional status. Simultaneously, detailed information was obtained concerning the environmental factors, both physical and cultural, of each village.

This field study and comprehensive investigation of the environmental factors demonstrated that the geographical pattern of the mortality tended to coincide with the physical geography of Guatemala. A mortality rate between 70 and 90 per cent of total deaths in the Coastal Lowlands occurred in pre-school children, whereas in the Central Highlands the mortality was low, 10 to 30 per cent. The incidence of kwashiorkor was 12 per 1000 of the sample population. The nutritional condition did not influence height or weight significantly, but the data did suggest that poorly nourished children grew more slowly than well nourished children. In villages with high mortality, for all subjects, 2.3 per cent were in the excellent nutritional status, 62.3 per cent were rated good, 28.3 per cent were regular, 7.1 per cent were bad; in villages with low mortality, for all subjects, 5.9 per cent were excellent, 65.1 per cent were average, 27.6 per cent were regular, 1.4 per cent were bad. The incidence and intensity of malnutrition did not seem sufficient to account for the great difference in mortality. The variation in mortality appears to reflect a composite of many environmental factors.

Microfilm $2.85; Xerox $9.80. 218 pages.

A GEOGRAPHIC ANALYSIS OF INTER-ISLAND TRANSPORTATION IN THE LESSER ANTILLES AND HAWAIIAN ISLANDS.

(L. C. Card No. Mic 59-4989)

David August Smith, Ph.D.
University of Michigan, 1959

Island chains, by virtue of their non-contiguous geographies, face problems of inter-connecting transportation which are not found in continental areas. The Hawaiian Islands and the islands of the Lesser Antilles of the West Indies have attempted to solve these problems in different ways. The purpose of this paper is twofold: first, to contribute to the literature on regional transportation, very little having been written on the transport system of either island chain; second, to describe the influences which have brought about differences in inter-island transportation in two physically similar groups.

Two methods were used in studying the inter-island transportation systems of the Lesser Antilles and Hawaiian Islands. A subjective method was used in the study of the development, importance, efficiency, and problems of the transportation systems. This was done largely by personal interviews, letters, and consulting the available literature. An objective method was used in the study of the patterns created by inter-island movement. This was based on statistics on port entrances and clearances, cargo handled, passengers carried, and imports and exports.

The results of the two methods show two widely divergent systems of transportation. In the Lesser Antilles the pattern formed by inter-island transport is one of many fragments, drawn together to form a whole. Almost every island is the nucleus of a cluster or knot of transportation lines. The clusters vary in size and importance dependent upon the islands which they include.

Inter-island transportation in the Lesser Antilles has progressed so slowly that it can be said to have stagnated. The original inter-island vessel, the dugout canoe, was replaced by the sailing ship. Here progress ceased, and only in recent years has motorized transportation begun to compete with the schooner and sloop. The sailing vessel, still a ubiquitous feature of Caribbean ports, has been able to maintain its position by virtue of the low cost transportation it can offer.

Inter-island transportation in the Hawaiian Islands has followed a more logical development. Improvements have been readily adopted, so that today goods move via barges pulled by tugs while passengers travel via airplane. Each new method of transport has been utilized in an attempt to offer more efficient service at lower cost.

The pattern which inter-island transportation creates in the Hawaiian Islands is much different from that formed in the Lesser Antilles. In the Territory of Hawaii, the pattern is approximately that of a wheel with Honolulu at the hub. By far the greatest amount of movement within the chain takes place between outlying ports, or airports, and Honolulu.

The factors which contribute to these differences are many, no one of which can be said to be entirely dominant. Political organization has affected the patterns of transport in each chain by erecting barriers to movement in the West Indies but not in the Hawaiian Islands. The distribution of population has also affected the pattern. Honolulu dominates the Hawaiian chain much more than any one city influences the Lesser Antilles. The economic conditions in the two chains have had probably the greatest effect. The differences in the two transportation systems are in a large part due to the differences which exist between an economy which is highly developed and one which is not far removed from the subsistence level.

Microfilm $2.25; Xerox $7.80. 169 pages.

GEOLOGY

ENVIRONMENTAL STUDIES OF THE LOWER TERTIARY FORMATIONS IN NEW JERSEY.

(L. C. Card No. Mic 59-3564)

John Kendal Adams, Ph.D.
Rutgers University, 1959

Major Professors: Dr. Steven K. Fox and
Dr. James H. C. Martens

This report describes the sediments of early Tertiary age which crop out in New Jersey. The formations include the Hornerstown marl, the Vincentown sand, and the Manasquan marl.

Texturally, the Hornerstown formation ranges from sand to sandy-clay; the Vincentown ranges from sand to silty-sand and clayey-sand; the Manasquan ranges from silty-sand to clayey-sand and sand-silt-clay.

Petrographically, the lower Tertiary formations of New Jersey may be described as a mixture of three principal minerals: glauconite, quartz and calcite. The Hornerstown marl is composed chiefly of glauconite; the Vincentown sand is composed chiefly of quartz or calcite or both; the Manasquan marl is a mixture of quartz and glauconite. The clay minerals include glauconite, illite, montmorillonite is, in general, absent from the Hornerstown formation, but it is usually present in the Vincentown and Manasquan formations. The detrital heavy mineral suite is large containing twenty-two mineral species or groups. The principal detrital heavy minerals include black opaques, leucoxene, epidote, hornblende, garnet, kyanite, mica, rutile, sillimanite, staurolite, tourmaline and zircon. The authigenic heavy minerals include collophane, pyrite and limonite.

Twenty-five species of Ostracoda are recognized from the lower Tertiary formations of New Jersey. Six new species and one new variety are described. The lower Tertiary ostracods are clearly different from those in the Upper Cretaceous Red Bank formation.

The available data suggest that the lower Tertiary sediments of New Jersey are of marine origin and were deposited in relatively shallow water. Tidal currents were effective in distributing the sediment some of the time. Reducing conditions prevailed in the bottom sediments during the time the Hornerstown formation was being deposited and locally during the time of deposition of the Vincentown and Manasquan formations. The Vincentown formation may have been deposited in a shallow bay, the center of which was a haven for a cosmopolitan benthonic community.

The source area for the lower Tertiary formations of New Jersey was the marine Cretaceous formations of the northern Atlantic Coastal Plain; possibly some of the sediment was derived from the Piedmont or Appalachians.

Microfilm $2.80; Xerox $9.60. 213 pages.

THE GEOLOGY OF THE KNIGHT RANGE, GRANT COUNTY, NEW MEXICO.

(L. C. Card No. Mic 59-4487)

Donald Lawrence Ballmann, Ph.D.
University of Illinois, 1959

Precambrian granite, intruded by dikes of Precambrian diabase, is present on the northeast and southwest sides of the Knight Range.

Outliers of Cambro-Ordovician Bliss sandstone and Ordovician El Paso limestone, whose thicknesses are approximately the same as those of these same units elsewhere in the Silver City region, suggest that the uplift of the Big Burro Mountains did not begin in Precambrian time.

An arkose, possibly the Lobo (?) formation of Cretaceous (?) age, is present locally above the Precambrian granite.

Tertiary volcanic rocks consisting of a lower rhyolitic series of lavas, tuffs and agglomerate, early andesitic lava and tuff, and middle rhyolitic breccia, lava and tuffs, accumulated to a thickness of over 5,000 feet. Andesite was intruded locally along minor faults. Two large perlite bodies are among the early rhyolitic rocks.

Erosion in nearby areas furnished detritus for the lower beds of Gila conglomerate. Faulting along the Taylor Fault on the northeast side of the range began at this time. Continued downward movement along this fault furnished a kind of basin in which the upper beds of the Gila accumulated. Greater displacement in the northern half of the range produced hinge faulting along the Malone Fault which bounds the northern half of the range on the west.

Several phases of late volcanic activity in Quaternary time produced rhyolitic cones and intrusive bodies, dacite lave, and andesitic lava and tuff which overlie the tilted rocks of the Knight Range with an angular unconformity. Later Quaternary events include the deposition of high level gravels, pediment gravel, and alluvium, together with dissection of the range and some cross faulting to the present time. Microfilm $2.00; Xerox $4.00. 73 pages.

CHARACTERIZATION OF ILLITE AND ITS ASSOCIATED MIXED LAYERS.

(L. C. Card No. Mic 59-4494)

Bruce Forbes Bohor, Ph.D.
University of Illinois, 1959

Five illitic materials from three different depositional environments - marine, brackish-water (underclays), and glacio-lacustrine - were studied in order to provide data on the illite group characteristics and also to determine the nature of the mixed-layering often associated with illite. X-ray diffraction patterns of illitic materials commonly

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

show a low-angle skewness of the illite basal (001) diffraction peak; it is this skewness that was the object of the mixed-layering investigation.

The five illitic clay materials were purified as much as possible by sedimentation and only the relatively illite-rich fraction less than 0.5 microns in diameter was used in the analyses. The relative amount of illite in all the samples was about 60% and the mixed-layering varied from 17% to 31%; kaolinite, chlorite and montmorillonite in smaller amounts made up the remainder of the clay compositions.

The cation-exchange capacity and exchangeable cation content were determined for several size fractions of the clays. The clays were saturated with several different metallic cations and X-rayed at 25° C. and over 200° C. At room temperature (25° C.), the amount and spacing of the mixed-layering increased with adsorption of most of the cations; when the adsorbed water was driven off above 200° C., the divalent and larger monovalent cations exhibited a "propping" action that prevented the complete collapse of the mixed-layering to the illite spacing (10 Å).

Powder X-ray diffraction patterns of the five clays revealed 2M, 1M, and 1Md mica polymorphs to be present in all the clays in varying proportions. The position of the 060 maxima indicated that all of the illites are dioctahedral.

Heating of the untreated and cation-saturated clays to over 1400° C. was accomplished in a high-temeprature X-ray diffraction furnace. The mica anhydride structure breaks down at 950° C. into spinel, gamma-alumina, a small amount of beta-quartz and probably some amorphous silica. Mullite is the major high-temperature phase in these clays and usually begins forming around 1250° C. When beryllium and tin are the exchange cations, however, mullite begins forming immediately upon collapse of the mica-anhydride, and develops its maximum intensity with these cations. No cristobalite was detected in any of the high-temperature runs, in marked contrast with the published high-temperature phases of montmorillonites which show a strong development of cristobalite. The effectiveness of the various exchange cations in promoting the development of mullite and the other high-temperature phases follows the series: $Sn^{++} > Be^{++} > Mg^{++} > NH_4^+ > Ca^{++} > Li^+ > Na^+ > K^+$.

The Fourier transform method was applied to the interpretation of the mixed-layering in the illites. The presence of a 12.2 Å spacing in all the illites was discovered; this spacing was attributed to monolayer hydration of illite units, or "degraded illite." The skewness of the illite 001 basal diffraction peak is explained by the discovery of this component. Microfilm $2.20; Xerox $7.60. 165 pages.

GEOLOGY OF THE SOUTHERN WET MOUNTAINS, COLORADO.

(L. C. Card No. Mic 59-4889)

Robert Ernst Boyer, Ph.D.
University of Michigan, 1959

The Wet Mountains, south-central Colorado, may represent a key to the structural complexity of the Southern Rocky Mountains. This investigation, the first detailed study of the southern Wet Mountains, yielded information necessary to interpret the geologic history of this area, and furnished insight into such geologic problems as igneous rock emplacement, the nature of metamorphic rock deformation, and the role of granitization in the development of hybrid rocks.

Emphasis centered on examination of the Precambrian core of the range. This core consists in part of metasedimentary gneisses and schists concordantly foliated with gneissic granites and hybrid rocks, migmatite and lit-par-lit gneiss. Foliation within these units has an arcuate east-west strike and steep north dip and represents modified original sedimentary stratification subsequently isoclinally folded and steeply tilted to the north. Intruded into the above sequence are several younger Precambrian granite plutons whose foliation (platy flow structure) is discordant to that of the older units. Most extensive of these plutons is the San Isabel batholith, a biotite-microcline granite which is characteristically coarse-grained and markedly porphyritic.

Steep northerly plunging lineation is found in all the Precambrian units. In the metasedimentary and hybrid rocks it is an "a" lineation, developed in the foliation planes essentially perpendicular to the fold axes and formed during isoclinal folding of the original sedimentary sequence. Lineation (linear flow structure) within the younger granites is shown by preferred orientation of prismatic minerals. Concentric outward-dipping lineation within the San Isabel granite suggests intrusion in the shape of an inverted cone.

Heavy mineral investigations placed emphasis on the younger granites. Results included: (1) apatite, sphene and zircon proved most useful to correlate rock types; (2) granites in the Wet Mountains appear dissimilar to granites of Huerfano Park and the Sangre de Cristo Range; (3) the San Isabel granite more closely resembles the Pikes Peak granite than any other granite of the Front Range.

High-angle normal faults with a dominant N. 60° W. trend, parallel to the range axis, border the complex and give rise to prominent structural terraces on the mountain slopes. Some of the faults represent Precambrian shear zones, but major movement occurred from late Cretaceous to mid-Tertiary. During this time the Wet Mountain massif acted as a resistant block to regional compression and was forced upward, moving in stages along the northwest-trending faults.

A nearly vertical joint set trending N. 60° W. contains abundant Tertiary(?) acid and basic dikes. A less prominent nearly vertical joint set with fewer dikes strikes N. 40° E. The jointing is the result of Precambrian structural events with minor intensification during later orogenic epochs (Ancestral Rocky Mountains, Laramide orogeny, and Tertiary block uplifting).

Miocene volcanic rocks composed of crystal vitric rhyolite tuff of lacustrine-fluviatile origin, overlain by andesite flows, are found as scattered erosional remnants. Greenhorn Peaks, highest points at the Wet Mountains' southern end, are the most extensive of these remnants. Also present is a Tertiary hypabyssal quartz-poor rhyolite stock.

Sedimentary rocks bound the Precambrian core with high-angle fault contacts. Jurassic and Cretaceous rocks, particularly the Morrison and Dakota formations, are common along the contact. Tertiary sedimentary rocks occur in the lowlands which border the massif.

Abandoned workings and numerous scattered prospects

testify to extensive low-grade mineralization. The most significant deposit, a Precambrian zinc sulphide replacement body, is found at the Marion mine and nearby smaller workings. Microfilm $3.20; Xerox $11.00. 246 pages.

GLACIAL GEOLOGY OF THE SWIFT CURRENT AREA, SASKATCHEWAN.

(L. C. Card No. Mic 59-4501)

Earl Alfred Christiansen, Ph.D.
University of Illinois, 1959

Three Wisconsin till sheets (Wymark Till, Aikins Till, and Leinan Till) and the end moraines of the latter two occur within the Swift Current area. These till sheets are separated by outwash and lacustrine sands, silts, and clays which were deposited during the retreats and advances of the ice sheets. The lack of weathering, except for oxidation, indicates that the three till sheets represent local fluctuations of the glacier during the major retreat. The montmorillonite (most abundant clay mineral) and illite in the tills were derived from the Upper Cretaceous Bearpaw Formation whereas the kaolinite was derived from the Whitemud Formation of the same series. The general direction of ice movement was from the northeast, although locally, the direction varied considerably.

A loess blanket, which is post-Aikinsian and pre-Leinanian, was derived from the outwash plain west of the city or Swift Current. The clay minerals of the loess, like those of the tills and lacustrine clays, are essentially montmorillonite and minor amounts of illite and kaolinite.

Slumping occurs in valleys where streams have cut through the drift into the Bearpaw Formation. When streams cut below this contact, the confining pressure is reduced sufficiently to cause the plastic shales to move laterally into the stream valley. The movement of the shale places the overlying competent drift in a state of tension, and fractures are formed. These fractures greatly reduce the internal shear resistance within the drift, and slope failure occurs. Valley widening by this process occurs very rapidly and is related to drift-shale stratigraphy rather than time.

Nonsorted polygons and circles in soils are recent and not periglacial in origin. They are large-scale shrinkage cracks formed by desiccation. During dry periods shrinkage cracks develop into which material from the A_1 horizon is deposited. The cracks and associated infillings cause soil development to take place laterally and, as a result, vertically-plated, solonetzic A_2^1 horizons form ajdacent to them. As the process continues, more and more of the parent B horizon within the polygon is transformed to A_2^1 horizon until the nonsorted polygons become nonsorted cirlces. Microfilm $2.00; Xerox $5.00. 99 pages.

GEOLOGY OF THE MAGNETITE DEPOSITS AND ASSOCIATED GNEISSES NEAR AUSABLE FORKS, NEW YORK.

(L. C. Card No. Mic 59-4502)

Lorence Gene Collins, Ph.D.
University of Illinois, 1959

A number of replacement magnetite deposits occur in the pre-Cambrian gneisses and skarn near Ausable Forks, New York. Introduction of these deposits has been controlled in large part by local structural features. An area approximately 8 square miles was mapped on a scale of 1 inch to 880 feet, and two deposits, the Palmer Hill and Jackson Hill, were mapped on a scale of an inch to 200 feet. Petrologic interpretations have been based on field studies, 325 thin sections and polished surfaces, over 500 refractive index determinations, and 22 fluorescent x-ray analyses and 10 spectrographic analyses of rocks and minerals.

Petrographic studies indicate that in the gneisses, clinopyroxene has altered in part to hornblende, hornblende has altered to biotite, and biotite to several other minerals. The more intense the alteration, the lower the refractive index. Spectrographic and fluorescent x-ray analyses show that the lowered indices reflect a decrease in iron content of the minerals. The amount of disseminated magnetite in the gneiss host rock drops from about 4 percent at distances greater than 500 feet on either side of the ore bodies to 0 percent immediately adjacent to the ore bodies. Calculations indicate that more than enough magnetite has been removed from the gneiss to account for the magnetite bodies. Some of the iron in the ore bodies may also have come from the breakdown and alteration of the ferromagnesian silicates.

Magnetite mineralization associated with clinopyroxene skarn appears to have originated in a different manner from that in the gneiss. There is no gradual decrease in percent of disseminated magnetite near an ore body, and clinopyroxene does not break down to alteration products. Also, the refractive index of clinopyroxene in the host rock is nearly uniform. Magnetite seems to have been derived from recrystallization of clinopyroxene and hornblende gneisses rich in iron to form clinopyroxene skarn relatively poor in iron. The iron released during this recrystallization was precipitated as magnetite. Magnetite concentrations formed in this manner are small and scattered throughout the skarn.

Microfilm $2.20; Xerox $7.60. 165 pages.

BEDROCK GEOLOGY OF THE RANDOLPH QUADRANGLE, VERMONT.

(L. C. Card No. Mic 59-4292)

Ernest Henry Ern, Jr., Ph.D.
Lehigh University, 1959

The Randolph quadrangle is situated in central Vermont and lies on the east limb of the Green Mountain anticlinorium. To the east and southeast of the quadrangle are the Strafford and Pomfret domes which mark the southern limit of the Willoughby arch.

Paleozoic metasediments and metavolcanics, representing nine formations, are exposed in the Randolph quadrangle as a series of north-trending parallel belts. From west to east these stratigraphic units have been identified as the Ottauquechee, Stowe, Moretown, Cram Hill, Barnard gneiss, Shaw Mountain, Northfield, Waits River, Gile Mountain and Waits River formations.

The stratigraphic units west of the Cram Hill formation are part of a homocline on the east limb of the Green Mountain anticlinorium and dip steeply to the east. The two belts of the Waits River formation, east of the homocline, are considered stratigraphically equivalent. There is a second or eastern belt of the Gile Mountain formation (type locality) east of the Randolph quadrangle.

Graded bedding in the Randolph quadrangle designates the western band of the Gile Mountain formation as older than the Waits River formation. However, the western Waits River belt is conformably underlain to the west by the Northfield formation.

Argillaceous members along the margins of the western band of the Gile Mountain formation have been assigned to the Northfield formation and are correlated with the Meetinghouse slate which is exposed east of the eastern belt of the Gile Mountain formation.

An unconformity at the base of the Shaw Mountain is considered an erosional horizon and explains the absence of Gile Mountain lithology west of the Northfield formation.

Two stages of deformation are indicated by the development of two generations of minor folds and of cleavage. These minor structures are important in delineating the major structural relations.

The early minor structures in the eastern two-thirds of the quadrangle strongly suggest that the western band of the Gile Mountain formation is the nose and core of a major recumbent anticlinal fold or nappe-like structure which plunges to the north. The root zone of this major fold lies in the eastern band of the Gile Mountain formation.

The later minor structures are the result of the formation of the Strafford and the Pomfret domes. As the domes developed the axial plane of the recumbent fold was arched.

The present interpretation of the structure and stratigraphy calls for a revision of the stratigraphic units of east-central Vermont; namely, the sequence of formations above the Cram Hill is, from older to younger, Gile Mountain, Shaw Mountain, Northfield and Waits River.

A number of plutonic bodies are present in the Randolph quadrangle but they are small and have not appreciably affected the enclosing rocks.

Microfilm $2.30; Xerox $8.00. 173 pages.

GEOLOGY OF THE ISLAND POND AREA VERMONT.

(L. C. Card No. Mic 59-4294)

Bruce Kesseli Goodwin, Ph.D.
Lehigh University, 1959

The Island Pond quadrangle is in northeastern Vermont. It is located between the Green Mountain anticlinorium and the Connecticut River.

Two recognizable metasedimentary formations are exposed within the quadrangle; the Gile Mountain formation and the Waits River formation. The Gile Mountain formation, composed predominantly of phyllites, schists, and quartzites, correlates with the Westmore formation as the two formations unite in a structural closure in the southwestern portion of the map area. The Waits River formation, of predominantly calcareous lithology, is believed to be the youngest metasedimentary unit present. A thin amphibolitic band lying approximately at the boundary between the Waits River and Gile Mountain formations is tentatively designated as the Standing Pond volcanics. Although not locally distinguishable, the Northfield and Meetinghouse slates, herein considered to be correlatives, may be present as phyllites and schists occupying a stratigraphic position between the Waits River and Gile Mountain formations.

The metasedimentary rocks of the Island Pond quadrangle are predominantly overturned and have been subjected to at least two periods of deformation. The deformational stages are demonstrated by two generations of folds and cleavage. Characteristic of the early deformational stage is a schistosity parallel or subparallel to bedding which acts as an axial plane cleavage to a series of small, tight folds. Slip cleavage cutting the earlier schistosity is a product of a later stage of deformation and is parallel to the axial planes of later folds formed contemporaneously with the slip cleavage.

An analysis of major and minor structural features strongly suggests that the metasediments of the Island Pond area occupy the central portion of the inverted limb of a large recumbent anticline. The "Brownington syncline" occupies the inverted crest of the recumbent anticline. The root zone of the recumbent anticline lies to the east of the Island Pond quadrangle and the structure plunges northeast. The Willoughby arch is a product of domal deformation on this inverted limb, its development giving rise to slip cleavage and folds of the second stage of deformation. These folds face away from the crest of the arch. The northern terminus of the Willoughby arch is in the southwestern portion of the map area where the bedding and early schistosity clearly swing around to delineate a structural closure. This closure is also indicated by the formational contacts.

Granitic rocks occupy about two-thirds of the map area. Three major granitic bodies are present: the Averill granite, the Nulhegan quartz monzonite, and the Echo Pond granitic complex. The last two are herein newly named. Rocks of the Averill granite range in composition from granite to granodiorite while those of the Echo Pond granitic complex range from granite to gabbro. The Nulhegan quartz monzonite is comparatively uniform.

The large granite bodies of this area clearly are intrusive. This is indicated by: rotated xenoliths; alignment of xenoliths, flow lines, and the contact with metasediments; pronounced contortion of metasediments near the contact with granite; decrease of metamorphic grade away from the granites. Microfilm $2.75; Xerox $9.40. 210 pages.

GEOLOGY OF THE WEST TINTIC RANGE AND VICINITY, TOOELE AND JUAB COUNTIES, UTAH.

(L. C. Card No. Mic 59-4860)

Sidney Lavern Groff, Ph.D.
University of Utah, 1959

Chairman: Dr. N. C. Williams

The area discussed comprises approximately 200 square miles and includes the West Tintic Range and part of the Sheeprock Range. The area is near the eastern boundaries of Tooele and Juab Counties, Utah, and is less than ten miles west of the Tintic mining district. Utah Highway 36 forms the northern boundary, and the Jerico Road forms the southern boundary. The eastern and western boundaries are defined by longitudes 112° 15' and 112° 25' 15" West respectively.

Sedimentary and metasedimentary rocks exposed within the area, include from older to younger: at least 13,000 feet of Precambrian schist, banded and unbanded phyllite, tillite, quartzite, argillite, and conglomerate of the Sheeprock series, and the Mutual(?) formation; at least 11,500 feet of Paleozoic carbonates and clastics which represent parts of all periods except the Permian; Tertiary strata, thought to represent all of the Tertiary epochs, and possibly being several thousand feet in thickness; several hundred feet of Pleistocene pediment gravels, recent alluvium and aeolian deposits. Mesozoic sediments, with the possible exception of an unnamed greenstone, are absent from the area.

Igneous rocks include the West Tintic monzonite intrusive and a younger granite intrusive. Extrusive rocks are abundant in the area and include from the oldest to the youngest: a diabasic rock, which may represent a Precambrian flow; a rhyolite sequence, tentatively correlated with the Packard latite of the East Tintic Range; an andesite and agglomerate sequence which unconformably overlies the granite is intercalated with beds of known mid-Eocene Green River age, and is correlated with the latite and agglomerate sequence of the East Tintic Range; a few remnants of basalt flows, probably of late Tertiary or early Quaternary age.

Three orogenic episodes are recognized and attributed to Cretaceous, earliest Tertiary, and later Tertiary phases of deformation. These episodes are tentatively considered to correlate in time with the Cedar Hills, Laramide, and Basin and Range orogenies which are more specifically recognized in nearby areas. More precise dating of pre-Tertiary deformation is not possible because of the absence of Mesozoic sediments critical to such dating. Structures considered contemporaneous with the Cedar Hills orogeny include the West Tintic anticline, the Brown's Ridge homocline, and the monocline north of Little Valley. Structures assigned to the Laramide orogeny include the Sheeprock thrust system and recumbent folds and tear faults in the allochthon. The Basin and Range structural features consist of range-defining high-angle faults such as the Vernon Creek fault and flexures and folds in the Green River-Salt Lake strata.

The West Tintic and Blue Bells mining districts are in the Sheeprock portion of the area. The West Tintic district has a history of sporadic production since 1870, with production of minor amounts of gold, silver, lead, copper, tungsten, and iron ores. Nearly all production came from the Scotia mine. At present (1957), there is no mining activity in the West Tintic district. The Blue Bells mining district contains the only current operation in the area, the Blackhawk properties, which have produced several thousand dollars in high-grade silver ores in recent years.

There are no records of production of metallic minerals from the West Tintic Range. However, large deposits of jasperoid may be an indication of possible mineralization at depth. Barring this possibility, the prospects of important mineral development in the West Tintic Range is considered unlikely.

Microfilm $3.15; Xerox $10.80. 244 pages.

GEOELECTRICAL INVESTIGATIONS IN THE LOWER PALEOZOIC OF CENTRAL PENNSYLVANIA.

(L. C. Card No. Mic 59-5110)

Gerardo Wolfgang Gross, Ph.D.
The Pennsylvania State University, 1959

Self-potential and resistivity investigations were carried out in a section of the lower Paleozoic of Central Pennsylvania and, in particular, on the residual overburden of the Cambrian Gatesburg formation. Broad negative self-potential ("first-order") anomalies (contrast of 120-350 mV) were found to characterize the sandy Gatesburg overburden with respect to adjacent formations. Limonite deposits are not directly related to nor responsible for these anomalies.

Kaolinite clays are frequently associated with the limonites or form separate deposits. They are in many cases characterized by "second-order" positive SP anomalies. Their contrast is of the order of 50-60 mV and their width, of hundreds of feet. They are located at the bottom or on the flanks of first-order anomalies.

Both first-order and second-order anomalies show a characteristic inverse relationship with apparent resistivity values in most cases.

All the available evidence, geological and geophysical, indicates that the anomalies are caused by electrochemical, viz.: liquid-junction (diffusion) and shale potentials. Concentration gradients between interstitial infiltration waters and perched water tables within the very sandy Gatesburg overburden are believed to give rise to the former. Shale potentials are generated by two distinctly different structures:

1) At the contacts of clay-rich autochthonous soils characterizing formations above and below the Gatesburg, with the sandy overburden of the latter. These give rise to first-order anomalies.

2) At the boundary of clay lenses and layers within the sandy matrix of the Gatesburg overburden itself. Such bodies of clay are usually responsible for the perched water accumulations mentioned. This is the origin of second-order anomalies.

A detailed study on a second-order positive anomaly on the property of the Woodbury Clay Co. has confirmed the preceding conclusions and shown a qualitative agreement to exist between geophysical results and borehole information. This study indicates that commercial white kaolinite clay beneath no more than 30-40 ft of overburden is present under resistivity minima in the range between

roughly 2000 and 3500 ohm-meters coupled with SP maxima of 50-60 mV contrast. An SP-resistivity ratio has been defined which combines these two categories of information into one parameter which is useful for graphical representation.

Combined SP and resistivity surveys are useful as a prospecting tool for clays in the region under consideration. It is felt that SP surveys alone are adequate for outlining the first-order anomalies within which (bottom or flanks) the second-order peaks are found. In the preliminary survey when looking for first-order anomalies, electrode spacings of 200 ft or more are recommended. Second-order anomalies should be sought with SP spacings of 100 ft or less, and resistivity should be used as an auxiliary tool. Microfilm $2.00; Xerox $7.00. 146 pages.

GEOLOGY AND STRUCTURAL DEVELOPMENT OF THE ANDEAN SYSTEM OF PERU.

(L. C. Card No. Mic 59-4928)

Henry Liggett Hosmer, Ph.D.
University of Michigan, 1959

The mountain ranges of Peru form a well-defined part of the Andean orogenic belt that follows the western margin of South America. This report summarizes the record of rocks, structures, and surface features of the Andean system in Peru and describes the tectonic evolution of the system as revealed by this record.

The Andean system developed from a marginal orthogeosyncline that has been the site of repeated geosynclinal depression and subsequent orogenic deformation and magmatic activity. The early history of the region is obscure, but the igneous and metamorphic rocks of the basement complex bear witness to at least two diastrophic cycles in the Precambrian. Two diastrophic cycles, each beginning with geosynclinal sinking and terminating with orogenic deformation, are inferred from the poorly known Paleozoic record. The lower Paleozoic geosyncline and late Devonian orogenic belt appear to have developed largely in the eastern part of the orthogeosyncline. The upper Paleozoic geosyncline probably occupied the western part, and medial Permian deformation took place along the western edge of the orthogeosyncline.

The Mesozoic was characterized by geosynclinal subsidence and deposition of thick bedded assemblages in much of the orthogeosyncline. A complex geosyncline formed, consisting of two troughs of subsidence and sedimentation separated by a median geanticline. A miogeosynclinal assemblage of sandstone, shale, and carbonate rock accumulated in the eastern and much of the western trough. A volcanic archipelago existed along the western margin of the geosyncline and contributed a eugeosynclinal assemblage of volcanics and clastic sediments to the western trough. Volcanism and tectonic movements in the archipelago were most intense in the Triassic and Jurassic, during early development of the geosyncline, and diminished in the Cretaceous, during the later stages of development. Geosynclinal subsidence was sporadic and was interrupted by episodes of uplift and deformation. Five disturbances are indicated by the stratigraphic record. These were (1) in the late Lower Jurassic, (2) in the late Middle Jurassic, (3) in the medial Upper Jurassic, (4) in the earliest Cretaceous, and (5) in the medial Cretaceous.

During the late Mesozoic and Cenozoic, the geosynclinal belt underwent a succession of orogenic deformations which encompassed the entire orthogeosyncline and gave rise to the Andean deformed belt. The tectonic pattern of the deformed belt presents an asymmetric arrangement of structural zones that closely reflect the distribution of the earlier geosynclinal structures.

The deformed belt embraces three major structural provinces in Peru. The western border zone developed from the earlier volcanic archipelago and was subjected to vertical movements during the deformational phase. Tensional breakdoen, with repeated block faulting, took place locally.

The cordilleran zone developed from the western geosynclinal trough and median geanticline and was the scene of repeated compressional deformation and intrusion during the Andean orogeny. Three deformational stages, in the medial Upper Cretaceous, the early Middle Eocene, and the Lower Oligocene, are recognized. Following consolidation of the geosynclinal deposits by orogenic processes, the province underwent intermittent uplift, with attendant volcanism, in the late Tertiary and Quaternary to form the Andean chain.

The subandean foreland zone developed from the eastern geosynclinal trough, which sank as a foredeep during and following the Andean orogeny. Compressional deformation in the early Pliocene (Subandean orogeny) produced the subandean anticlinal ranges.

Continuing tectonic activity in the region is indicated by the presence of marginal deeps, negative gravity anomalies, seismic activity, and volcanism. The relationship of this diastrophism to the earlier orogenic phases is, however, not clear.

The history of structural development of the Andean system of Peru suggests certain generalizations of tectonic behavior that may be applicable in the interpretation of other orogenic systems.

Microfilm $4.10; Xerox $13.80. 320 pages.

PETROGRAPHY AND STRUCTURAL SIGNIFICANCE OF THE MAFIC IGNEOUS ROCKS IN THE ISHPEMING-NEGAUNEE AREA, MARQUETTE IRON RANGE, MICHIGAN.

(L. C. Card No. Mic 59-2588)

David L. Mathias, Jr., Ph.D.
Columbia University, 1959

The mafic rocks in the Ishpeming-Negaunee area are locally referred to as diorites or greenstones. Actually they are metamorphosed rocks of original basaltic composition. Observation showed that:

1. Interpretation of the structure, hitherto regarded as anomalous or at best difficultly understood, was greatly facilitated by correlation of the igneous units, which can be dealt with as stratigraphic entities.

2. The thick, conformable sheets can be classified on the basis of megascopic and microscopic texture and stratigraphic position into six distinct units.
3. Variations observed are representative of individual sheets and are not merely differences which might be expected in a single unit.
4. Megascopic identification in this area is safer and surer than microscopic classification.
5. The basaltic rocks have been regionally metamorphosed to the middle green schist facies, but generally retain relict igneous textures.
6. The basaltic magma was tholeiitic.
7. The basaltic rocks belong to the early and middle stages of fractionation of basaltic magma, and were relatively undifferentiated.
8. The large mafic units outline several large secondary folds.
9. Volcanic activity and a quasi-contemporaneous hypabyssal phase began in early Negaunee time and probably continued through the Clarksburgh period.
10. Early Huronian folding was on axes trending west, but the compressive forces were later rotated to a northeast-southwest direction with the formation of northwest-trending folds.
11. Regional metamorphism, "Killarnean" granite intrusion, and northwest-trending folds seem to be interrelated.
12. Keweenawan and post-Keweenawan dikes are recognized. Microfilm $2.00; Xerox $6.00. 124 pages.

CLAY MINERALOGY OF SOME CARBONATE ROCKS OF ILLINOIS.

(L. C. Card No. Mic 59-4545)

Meredith Eggers Ostrom, Ph.D.
University of Illinois, 1959

This paper presents the results of an investigation of the clay mineral components of 57 limestone and 44 dolomite samples, and of their 28 associated shale and clay partings and 3 sandstone lenses, collected from various marine or marine-terrestrial environments.

A thorough search of the literature failed to reveal a generally applicable method for liberating clay minerals from carbonate rocks hence it was necessary to develop such a procedure. A major problem was that of freeing the clay minerals without altering their character. The technique developed, utilizes weak solutions of acetic or hydrocholoric acid. By removing a portion of the released clay from the acid mixture before all of the carbonate is dissolved it is possible to obtain unaffected clay mineral components. The reliability of the method was checked and demonstrated by tests on a number of clay mineral materials commonly found in sedimentary rocks. The most acid-sensitive material was found to be a moderately homogeneous mixed-layer assemblage composed of hydrated and nonhydrated mica layers.

The dominant clay mineral in the carbonate rocks studied and in their associated shale and clay partings is illite, although any of the major clay components noted may occasionally be dominant. Montmorillonite was identified only in mixed-layer assemblages with illite.

No particular clay mineral was found to be restricted to a particular environment. However, the degree of crystallinity of a given clay mineral component, or variations in relative abundance between the components, is believed to have potential use for environmental differentiation of carbonate rocks if applied discriminately. The clay minerals associated with deposits believed to have been more significantly influenced by terrestrially derived material are less well-crystallized than those found in distinctly marine deposits. In addition, certain of these clay minerals, notably kaolinite, are commonly major components of the former environment and of rare occurrence in the latter. Therefore, it is suggested that as one proceeds from a dominantly terrestrial environment to a marine environment the degree of influence of the terrestrial environment on the clay minerals decreases and that of the marine environment increases. This influence is operative as near shore sedimentation of certain components such as kaolinite, and change of others, such as degraded illite, to better crystalline varieties in normal marine waters of higher salinity.

A comparison is made between the depositional environment and clay mineral character of the carbonate rocks studied and the clay mineralogy and environments of other recent and ancient carbonate rocks, but so little is known regarding the clay mineral composition of the latter that no conclusive relationships can be demonstrated. However, available data suggest that clay minerals are probably effected by environmental conditions at the site of sediment accumulation and that identification of carbonate environments of deposition may be greatly enhanced by clay mineral studies.

Microfilm $2.20; Xerox $7.80. 167 pages.

STRATIGRAPHIC SECTION AND FUSULINIDS OF THE BIRD SPRING FORMATION NEAR LEE CANYON, CLARK COUNTY, NEVADA.

(L. C. Card No. Mic 59-4556)

Mark Rich, Ph.D.
University of Illinois, 1959

The thick section of the Bird Spring Formation near Lee Canyon, Clark County, Nevada, consists of more than 7,000 feet of predominantly carbonate beds that show no apparent major lithologic breaks. Megafossils collected from the basal 500 feet indicate that the lower 100 feet are Chesterian in age and that the Mississippian-Pennsylvanian boundary occurs within a transitional interval. Fusulinids collected from the remaining 6,500 feet of the formation indicate that all of the following divisions of the Pennsylvanian and Permian are represented: Morrowan, Atokan, Desmoinesian, Missourian, Virgilian, Wolfcampian, and Leonardian. The Pennsylvanian-Permian boundary is also gradational. A total of 2,600 feet of Chesterian and Pennsylvanian beds are present and 4,500 feet of Permian. Lack of important lithologic breaks and presence of all

major fusulinid zones indicate that deposition of the predominantly carbonate Bird Spring Formation was continuous from Late Mississippian, through the entire Pennsylvanian, and into at least the Leonardian of the Permian Period. The upper limits of the Bird Spring Formation could not be determined because of truncation by faulting.

Fusulinids representing Wolfcampian and Leonardian from the upper 3,800 feet of the formation were identified by Christy (1958) and include several species of Schwagerina and one species of each of the following: Pseudoschwagerina, Pseudofusulina, and Parafusulina. Fusulinids representing the Pennsylvanian and part of the Wolfcampian from the lower 3,300 feet of the formation were identified in the present study and include the following: Millerella marblensis, one unidentified species of Staffella, forms of Pseudostaffella, Profusulinella decora, Fusulinella devexa, Fusulina similis, Bartramella bartrami, two unnamed species of Pseudofusulinella, several species of Triticites, one form questionably referred to Dunbarinella, several species of Schwagerina, Pseudoschwagerina texana, and an unidentified form of Parafusulina.

Microfilm $2.45; Xerox $8.60. 188 pages.

PETROLOGY OF TERTIARY BENTONITES OF TEXAS

(L. C. Card No. Mic 59-4559)

Herman Ellis Roberson, Ph.D.
University of Illinois, 1959

On the basis of results from thin-section studies, differential thermal, and X-ray diffraction analyses of bentonite samples from the Jackson and Gueydan groups (late Eocene and Oligocene?) of Texas, there is evidence that:

(1) The bentonites from the Caddell and lower Manning formations (Jackson group) are generally composed of well-crystallized, Ca^{++} montmorillonites with very few impurities. The bentonites from the upper Manning formation and the Catahoula formation (Oligocene?) are generally composed of poorly crystallized montmorillonite, and sometimes contain a substantial amount of quartz, cristobalite, feldspar, and volcanic shards.

(2) There appears to be a direct relation between the crystallinity of the montmorillonite particles composing the bentonites and the mode of origin. Bentonites altered in situ are generally composed of well-crystallized montmorillonite, whereas re-deposited bentonitic material is usually composed of poorly crystallized montmorillonite.

(3) Bentonites from the Jackson group and Gueydan group appear to be purer in central Texas than in east or southwest Texas in that less quartz, feldspar, and clay minerals other than montmorillonite are found in the central Texas deposits.

(4) Potassium and lithium saturations along with subsequent treatments (heating and glycerol solvation) of the bentonite samples reveal that most of the bentonites are composed of complex mixtures of different types of montmorillonite particles. In all the particles, there is apparently some Al^{3+} for Si^{4+} substitution in the tetrahedral layer, and some of the particles are characterized by substantial amounts of such substitution.

(5) The samples with the most substitution in tetrahedral positions seem to exhibit the most intense differential thermal peak at 550°C. However, this relationship may not hold true for all the samples.

(6) Sodium montmorillonite particles may be separated from calcium montmorillonite particles by size fractionation. The finer portion composed of sodium montmorillonite particles exhibits a differential thermal peak at 550°C of lower intensity than the coarser portion composed of calcium montmorillonite particles. It is suggested that the coarser fraction contains more layers which are tetrahedrally substituted, but further study is considered necessary to verify this.

(7) The volcanoes which supplied the ash that has been altered to bentonite were most likely in sourhwest Texas, New Mexico, and northern Mexico. The high aluminum content in most of the bentonites is probably due to the high aluminum composition of the original ash.

(8) Many of the bentonites analyzed in this study probably formed from material which differed in source and was depostied under various environmental conditions. However, many of the bentonites from the Caddell and lower Manning formations in central Texas are thought to be lake deposits.

(9) Variations in physical properties from one sample to another may be due in many cases to mineralogic variations (e.g. amount of tetrahedral substitution of Al^{3+} for Si^{4+}) within the montmorillonite. minerals.

Microfilm $2.00; Xerox $4.60. 87 pages.

POST-CHELTENHAM PENNSYLVANIAN STRATIGRAPHY OF THE COLUMBIA-HANNIBAL REGION, MISSOURI.

(L. C. Card No. Mic 59-4567)

Thomas Kay Searight, Ph.D.
University of Illinois, 1959

The post-Cheltenham Pennsylvanian rocks in the Columbia-Hannibal region are Desmoinesian in age with the possible exception of the youngest deposit, the Moberly channel sandstone. All strata recognizable by lithology are of the lower Desmoinesian Cabaniss subgroup and the Marmaton group. The sediments are cyclic in character and can be correlated with equivalent beds outside the region. Individual cycles are greatly reduced in thickness, and some lithologic members are missing. The most persistent strata are the underclays, coal beds, black fissile shales, and limestones. The underclays are thicker than those in other areas and occupy the combined stratigraphic intervals of the missing members.

Deposition of Desmoinesian rocks from the underclay of the Croweburg coal (lower Cabaniss subgroup) through the Pawnee formation (lower Marmaton group) was continuous. The pre-Croweburg Cabaniss beds are clay with the exception of a thin limestone (Tiawah) and a thin coal bed (Tebo). Although the Krebs subgroup and most of the Cabaniss subgroup below the Croweburg cannot be differentiated by lithology, the sequence appears to be conformable. Therefore, a number of formations may be represented by clay.

In general, strata in the region are nearly flat lying to gently dipping. However, the regional attitude of beds is altered by several broad uplifts which follow the major northwest-southeast trend of structures in the Ozark region.

The Pennsylvanian sediments are preserved in a broad, shallow northwest-southeast trending syncline, which plunges to the northwest. The syncline is bordered by three major tectonic highs--the Lincoln-Cap au Gres anticline, the Ozark uplift, and the Saline County arch--which acted as barriers to sedimentation throughout much of the lower Desmoinesian. The major syncline is divided into small depositional basins by a series of minor tectonic highs. The most prominent of these folds conform to the structural grain of the region. The small basins are further subdivided by a secondary series of minor highs normal to the structural grain.

The following three factors were the most significant influences on the sedimentation of the Pennsylvanian: (1) The region was generally high and tilted to the northwest along the plunge of the major syncline. Although locally restricted by some of the minor tectonic highs, younger cycles overlap older ones from northwest to southeast. (2) The region did not subside sufficiently during some cycles for marine invasion, and, as a result, several cyclic sequences are restricted to underclay and coal beds or to underclay only. (3) The most complete cycles are developed in the minor basins. Many of the lithologic units thin rapidly and wedge out on the minor tectonic highs bordering the basins.

Microfilm $3.65; Xerox $12.40. 282 pages.

CLAY MINERALOGY OF PRE-PENNSYLVANIAN SANDSTONES AND SHALES OF THE ILLINOIS BASIN.

(L. C. Card No. Mic 59-4573)

Thomas William Smoot, Ph.D.
University of Illinois, 1959

The clay mineral composition of approximately 150 samples of pre-Pennsylvanian sandstones, argillaceous sandstones, and shales of the Illinois Basin have been investigated by x-ray diffractometry. Eighty percent of these are from Mississippian-Chester sediments; the remainder are from the Mississippian—Valmeyer Series, the Ordovician and Cambrian System. Ninety-five percent of the samples are from cores from producing and non-producing well bores; the remainder are from outcrops.

The permeable sandstone samples are characterized by a heterogeneous mixture of degraded illites and chlorites, kaolinite and only minor amounts of montmorillonite (if present). The shales are characterized by well crystallized illite and chlorite, minor amounts of degraded illite and chlorite, and rarely, trace amounts of kaolinite. These differences are apparent even in intimately interbedded sediments that apparently had the same source area and, consequently, the same original clay mineral suite. Therefore, it is concluded that the heterogeniety in the sandstones is brought about by degradation after lithification by circulating formation fluids which have varied in composition from time to time. The low permeabilities of the shales have prevented such circulation taking place, hence, the minerals have been protected from degradation.

Shale samples of approximately contemporaneous rock units, which derived their sediments from the same source area but were deposited in different environments, were among the samples investigated. Charts are presented which portray the changes in clay mineralogy from the near-shore environments to the off-shore environments; generally from north to south in the Illinois Basin. However, the farthest off-shore environments are generally found in the structurally lowest and deepest buried part of the Illinois Basin. From the clay mineral data that are compiled in these charts, it is concluded that kaolinite is generally restricted to near-shore facies. Further, illite increased in proportionate value generally from north to south or from near-shore to off-shore facies, apparently at the expense of degraded and mixed-layer mica-like clays. It is further concluded that the occurrence of well crystallized chlorite is erratic and seems to be an inherited component of the shales.

As it is assumed that a major proportion of the original clays deposited were degraded mica-like clays, especially during Chester time, it is apparent from the present mineralogy of the shales that the degraded clays were, at least in part, regraded to illite and possibly chlorite.

The evidence is not convincing as to whether the regradation is related to (a) distance from shoreline penecontemporaneous with deposition (or rate of sedimentation) or (b) depth of burial after lithification.

The clay mineralogy of the sandstones investigated indicates that the degraded and mixed-layer clay minerals may swell and disperse, causing plugging of reservoirs during secondary recovery of oil. Therefore, the presence of these components should be taken under consideration while planning a secondary recovery programs.

Some of the mixed-layer clay minerals, in the presence of hydrocarbons, apparently are protected from further degradation or water invasion (which would cause swelling and possibly dispersion) by organic molecules which encase the clay particles. Laboratory experiments indicate that the attraction between some of the organic compounds and degraded clay minerals is very strong.

The clay mineral analyses presented may be used profitably by the petroleum industry in the Illinois Basin as general guides in planning secondary recovery program.

Microfilm $2.00; Xerox $5.80. 120 pages.

STRATIGRAPHY AND PALEONTOLOGY OF A LATE PLEISTOCENE BASIN, HARPER COUNTY, OKLAHOMA.

(L. C. Card No. Mic 59-4994)

John James Stephens, III, Ph.D.
University of Michigan, 1959

Pleistocene (Illinoian) lake deposits are exposed in the Doby Springs area, Harper County, Oklahoma. The collapse basin in which these beds were deposited resulted from solution of salt or anhydrite in the underlying Permian strata. The rim of the basin is made up of the Permian Whitehorse group, the pliocene Ogallala formation and the Pleistocene (Kansan to Yarmouth) Crooked Creek formation.

In Kansan time a southeastward-flowing stream cut through the Ogallala formation into the Permian strata. This stream deposited the gravels, sands and silts of the Crooked Creek formation in its valley. During Yarmouth

time a caliche formed in the top of the formation. In Illinoian time a collapse basin formed in the Doby Springs area. Lake sediments containing the Doby Springs local fauna were deposited in this basin. Settling and collapse along the southern edge imparted the present dip to the lake beds. In Sangamon time the area was drained and a caliche formed in the upper part of the lake sediments. After this second caliche formation further collapse occurred to the north and imparted the northward dip to the northern part of the initial basin deposits. The present outward radial drainage results from the collapse on the margins of the initial basin. The alluvial deposits along the modern streams are of Wisconsin and Recent age.

The Doby Springs local fauna contained in the Illinoian lake deposits consists of the remains of ostracods, mollusks, fishes, amphibians, reptiles, birds and mammals. Only the fishes and the mammals have been studied. The seven fishes (Catostomus commersoni, white sucker; Semotilus cf. atromaculatus, creek chub; cf. Hybopsis gracilis, flathead chub; Pimephales promelas, fathead minnow; Ictalurus melas, black bullhead; Lepomis cf. cyanellus, green sunfish; and Perca flavescens, yellow perch) indicate a cool, upstream, lake environment with smaller streams running into the lake.

The mammals discussed, include twenty-four species belonging to seven orders, twelve families and seventeen genera. Of these, the following are extinct: two field mice, Peromyscus cf. cochrani and Peromyscus sp. nov.; mammoth, Mammuthus sp.; camel, Camelops sp.; bison, Bison cf. latifrons; and horses, Equus cf. niobrarensis and Equus sp.

The following extant mammals indicate a marsh environment with surrounding lowland meadows and some trees: four shrews, Sorex arcticus, S. cinereus, S. palustris and Blarina brevicauda; muskrat, Ondatra zibethicus; meadow vole, Microtus pennsylvanicus; and jumping mouse, Zapus sp.

The climate in the area is determined by plotting the present-day distribution of the living forms and arriving at an area of overlap. This area of overlap for the species recorded in the Doby Springs local fauna lies in southeastern North Dakota and northesatern South Dakota. The climate in Oklahoma during Illinoian time was probably similar to that in the area of overlap today. Lower summer temperatures and more effective moisture is indicated.

The Doby Springs local fauna is correlated with the Berends local fauna, Beaver County, Oklahoma, and the Butler Springs local fauna, Meade County, Kansas.

Microfilm $2.00; Xerox $4.00. 73 pages.

MORPHOLOGY AND TAXONOMY OF SOME MIDDLE SILURIAN OSTRACODA.

(L. C. Card No. Mic 59-4583)

John Ernest Nolan Wainwright, Ph.D.
University of Illinois, 1959

The most recent and most comprehensive systematic arrangement for Paleozoic ostracodes is that provided by Henningsmoen (1953). It involves rather drastic changes, in many respects, from the earlier classifications. Although this system is by no means ultimate and has been modified by Jaanusson (1957) and the present writer, it presents the first really unified classification of paleocope ostracodes.

The suborder Paleocopa Henningsmoen (1953) has been divided by that author into two superfamilies, the Beyrichiacea and the Leperditacea, each containing several families. Following Jaanusson's (1957) suggestion, the Beyrichiacea is herein restricted to those ostracodes displaying cruminal dimorphism, that is, those forms possessing a brood pouch as in the Beyrichiidae. The Kloedenellacea is comprised of those forms having a domiciliar mode of dimorphism, that is, an inflation of the domicilium of the kloedenellid or zygobolbid type. The Bolliacea includes paleocope ostracodes that do not exhibit dimorphism or in which dimorphic features have so far not been recognized.

Four families of Middle Silurian Ostracoda from the Middle Appalachian region of Pennsylvania, Maryland and West Virginia are represented in this investigation: the Beyrichiidae (Beyrichiacea), the Kloedenellidae and Zygobolbidae of the Kloedenellacea, and the Aechminidae (Bolliacea).

Representative specimens of several species have been serially sectioned transvere to the hinge line to investigate the nature of the hingement, overlap, and other detailed features of the carapace. Sectioning also served to clarify the relationship of the beyrichiid crumina (brood pouch) to the velate structure, and the significant differences between the beyrichiid and zygobolbid dimorphic inflations. Growth and variation within the several species observed is also considered. Microfilm $2.15; Xerox $7.60. 161 pages.

LOWER CRETACEOUS (ALBIAN) ROCKS IN NORTHERN GREAT PLAINS.

(L. C. Card No. Mic 59-5013)

George Richard Wulf, Ph.D.
University of Michigan, 1959

Rocks of Lower Cretaceous (Albian) age in Montana, North and South Dakota, and northeastern Wyoming have an average thickness of about 1000 feet and can be divided into three major facies: (1) the Dakota facies in eastern South Dakota, (2) the Blackleaf facies in northwestern Montana, and (3) the "basin" facies lying between and intertongued with the other two. A study of the lithofacies, paleontology, and tectonic aspects of the "basin" facies suggests that two major transgressive-regressive marine cycles occurred during Albian time.

After a period of non-deposition, marine waters from the Gulf region invaded the northern Great Plains. As this sea transgressed into Wyoming and Montana, the continental Aptian sands were reworked and redeposited into a blanket type sand called Fall River and First Cat Creek. The Fall River sandstone has been and still is called Dakota; this terminology should be avoided since the Fall River is the basal sandstone of the "basin" facies and is not correlative with the entire Dakota facies to the east. As waters became deeper black shale (Skull Creek) was deposited, and finally the sea retreated, and a vast delta was built out from central South Dakota into eastern Wyoming and southeastern Montana. The Newcastle

sandstone is a typical delta distributary sand, and the Birdhead sandstone is a shelf deposit marginal to the Newcastle delta complex. A study of the sedimentary structures in the New castle suggests that at least four superimposed delta lobes can be ascertained.

Much of the northern Great Plains then became land for a short period of time, and a very thin conglomerate layer was deposited at the top of the Birdhead sand. Before much erosion took place, a boreal sea invaded the area. In eastern Montana and western North Dakota a blanket type sand called Dynneson (new name; previously called Newcastel) was deposited. Some of the sand probably was derived from the upper part of the Newcastle delta, but much of it no doubt came from land areas to the east. The upper part of the Dynneson was deposited as a series of northeasterly trending features resembling offshore bars. Then the waters became deeper, and the sea spread farther to the east and south. Much volcanic ash fell and apparently changed the muds to highly siliceous clays resulting in the distinctive white Mowry shale. Near the end of Albian time the boreal sea retreated, but probably not all areas became emergent before another marine cycle began in Cenomanian (possibly late Albian) time.

Several of the Newcastle shoestring sandstones are the reservoirs of important oil pools, but most of these elongate sandstone bodies have not been tested. A study of the piezometric surface of the Dynneson and of isopachs of overlying strata suggests that much of the oil in this sandstone may be located in northwestern North Dakota.

Microfilm $4.50; Xerox $15.00. 350 pages.

HEALTH SCIENCES

HEALTH SCIENCES, PATHOLOGY

ISOLATION AND IDENTIFICATION OF A HITHERTO UNDESCRIBED STRAIN OF FELINE PNEUMONITIS VIRUS.

(L. C. Card No. Mic 59-4681)

Theodore George Yerasimides, Ph.D.
University of Pennsylvania, 1959

Supervisor: H. L. Ratcliffe

An agent related to the viruses of the psittacosis-lymphogranuloma group was isolated from the conjunctival exudate of a domestic cat during an attack of acute conjunctivitis. This agent was compared with the Baker's virus in its morphology, developmental cycle, host specificity, sensitivity to antibiotics and sulfonamides, hemagglutinin production for mouse erythrocytes, aand serologically by the complement fixation, virus neutralization and toxin neutralization reactions.

This agent was grown on the chorioallantoic membrane, in the yolk sac and allantoic cavity of chick embryos, in the lungs of mice and hamsters, and in tissue cultures of endodermal cells derived from the avascular membrane of 4-day old chick embryos. It underwent a developmental cycle comparable to that of the Baker's virus. Its developmental cycle on the chorioallantoic membrane of chick embryos, incubated at 35°-36°C, was estimated to be between 20 and 28 hours.

Antisera to this agent were produced in chickens, ducks and rabbits. Egg yolk containing neutralizing antibodies was obtained from the eggs laid by an immunized hen. Titration of the antisera and immune egg yolk was carried out in the yolk sac and on the chorioallantoic membrane of chick embryos. The chicken antisera were of higher titer than the antisera produced in ducks and rabbits. The immune egg yolk had a titer equal to that of the serum of the hen which produced it.

This agent was sensitive to terramycin, chloramphenicol and penicillin. It was not sensitive to streptomycin, bacitracin, sulfamethazine and sulfathiazole. It produced a toxin which was lethal to mice when injected intravenously. Neutralization of this toxic factor was accomplished by homologous antisera.

This agent, grown in the allantoic cavity of chick embryos, produced hemagglutinins for mouse erythrocytes. Complement fixation test showed that the antisera to this agent contained complement fixing antibodies which cross-reacted with the Baker's virus.

This agent was identified as a strain of the feline pneumonitis virus by the following:

1. It was indistinguishable from Baker's virus in its morphology, developmental cycle, growth characteristics in eggs and mice, host specificity, sensitivity to antibiotics and sulfonamides, hemagglutinin production for mouse erythrocytes, and complement fixation reaction.

2. It was distinguished from Baker's virus by:

(a) the toxin and virus neutralization tests which showed cross-neutralization by the antisera to this virus, but lack of reciprocal cross-neutralization by the antisera to the Baker's virus,

(b) the mouse toxicity test which showed this virus to be more toxic to mice, infective unit for infective unit, than the Baker's virus, and

(c) the effects of the toxin of this virus upon the livers of mice.

Presumptive evidence suggests that this virus may also infect man and cause conjunctivitis similar to that induced in cats. Microfilm $2.05; Xerox $7.40. 156 pages.

HEALTH SCIENCES, PHARMACY

EFFECT OF PREANESTHETIC MEDICATION ON BARBITURATE ANESTHESIA, HYPOTHERMIA, TRAUMATIC SHOCK AND LETHAL DOSE OF PENTOBARBITAL IN THE FELINE SPECIES.

(L. C. Card No. Mic 59-3738)

Donald Hanson Clifford, Ph.D.
University of Minnesota, 1959

The administration of the preanesthetic drugs meperidine (5 mgm./lb.), chlorpromazine (1 mgm./lb.), promazine (2 mgm./lb.), promethazine (1 mgm./lb.), trimeprazine (1 mgm./lb.), W 1527-63 (Warner Chilcott) (1 mgm./lb.) or perphenazine (1 mgm./lb.), alone prior to pentobarbital anesthesia in cats which were subsequently ovariohysterectomized did not significantly (one percnet level) effect the anesthetic dosage of pentobarbital or the time necessary to return to sternal recumbency when they were compared to a control group which was anesthetized with pentobarbital without preanesthetic medication. In combination chlorpromazine (1 mgm./lb.) and meperidine (5 mgm./lb.); promazine (2 mgm./lb.) and meperidine (5 mgm./lb.); promethazine (1 mgm./lb.) and meperidine (5 mgm./lb.); trimeprazine (1 mgm./lb.) and meperidine (5 mgm./lb.); and W 1527-63 (1 mgm./lb.) and meperidine (5 mgm./lb.) significantly decreased the anesthetic dose of pentobarbital. Only chlorpromazine and meperidine or promazine and meperidine significantly decreased the time necessary for these cats to return to a sternal recumbency.

In a second series of experimental cats, the same drugs alone and in combination were administered prior to pentobarbital anesthesia and exposure to cold to determine which anesthetic group was more depressing to the rectal temperature, heart rate, respiratory rate and return of reflexes. In general these functions were not as depressed when the preanesthetic agents were administered. The combinations of preanesthetic agents as listed were more effective than when they were used separately. The most effective combinations were chlorpromazine (1 mgm./lb.) and meperidine (5 mgm./lb.); promazine (2 mgm./lb.) and meperidine (5 mgm./lb.); trimeprazine (1 mgm./lb.) and meperidine (5 mgm./lb.); and perphenazine ($\frac{1}{2}$ mgm./lb.) and meperidine (5 mgm./lb.).

The overall effect of the preanesthetic administration of promazine (2 mgm./lb.), promethazine (4 mgm./lb.), meperidine (5 mgm./lb.), promazine (2 mgm./lb.) and meperidine (5 mgm./lb.) or promethazine (4 mgm./lb.) and meperidine (5 mgm./lb.) prior to pentobarbital anesthesia and mild surgical shock due to 30 minutes of intestinal manipulation was not remarkable when compared to pentobarbital anesthesia alone. The criteria used for this evaluation were blood pressure, oxygen consumption, hematocrit, blood volume, circulation time, body temperature, heart rate and respiratory rate. Oxygen consumption was significantly less at the one percent level four hours after shock when meperidine and promazine were administered prior to anesthetizing the cats. The respiratory rate prior to shock was significantly increased when promazine and promethazine were administered.

Preanesthetic administration of meperidine (5 mgm./lb.) and/or promazine (2 mgm./lb.) did not significantly alter below the one percent level the therapeutic ratio of intravenous pentobarbital in the cat; although, following promazine alone and promazine with meperidine the p value fell between two and five percent.

Meperidine and promazine were administered safely to an ocelot and a leopard prior to barbiturate anesthesia and euthanasia. These drugs facilitated restraint and decreased the dose of barbiturate required to produce anesthesia and death.

Microfilm $4.55; Xerox $15.20. 354 pages.

CONTROLLING DRUG ADULTERATION IN ENGLAND (1820-1906).

(L. C. Card No. Mic 59-3290)

Ernst Walter Stieb, Ph.D.
The University of Wisconsin, 1959

Supervisor: Associate Professor Glenn Sonnedecker

When, in 1820, the German-born chemist Fredrick [sic] Accum startled Londoners and others with his Treatise on Adulterations, the problem of drug adulteration was neither new, nor yet readily soluble. Eighteen hundred years before Accum's time, Dioscorides and Pliny spoke of extensive drug adulteration. In some cases they also described methods for detecting this adulteration, empirical but including some crude chemical and physical tests.

Many methods applied for the control of adulteration until the nineteenth century trace back, through medieval Arabic and Latin forms, to the Greeks and Romans. The nature of adulteration practices also changed only very little during the intervening eighteen centuries.

In spite of the significance of drug adulteration as an important social problem, the subject has attracted no serious historical studies thus far. Frederick A. Filby's History of Food Adulteration and Analysis (1934), one of the few studies of the important related subject of food adulteration, is limited largely to England in the period before 1820. Drug adulteration also presented an important issue facing the profession of medicine, and more particularly pharmacy, aside from the more general social aspects relative to the problem.

Among the Anglo-American countries, England first attempted comprehensive legal control of adulteration in the nineteenth century, which influenced later developments in the United States and Canada. For this reason, we have investigated the development of controls of drug adulteration in England between 1820 when Accum published his Treatise and 1906 when the United States enacted its first pure food and drug law.

In 1820 Accum had available, if he wished to use them, a number of physical and chemical tests applicable to the detection of adulteration; but most of these proved inadequate against drugs of animal and vegetable origin that formed the greater part of the materia medica of the time. More certain means of detection became available only thirty years later, after 1850, when the English physician Arthur Hill Hassall applied the microscope to the problem, in a comprehensive and systematic manner. Hassall's investigations of current adulteration practices provided a scientific basis upon which meaningful efforts at social controls could build, and stimulated the first English laws against adulteration in 1860, 1872, and 1875.

The Pharmaceutical Society of Great Britain had since its founding, in 1841, attacked drug adulteration as a professional problem; but not until the end of the nineteenth and early in the twentieth century did the British Pharmacopoeia become a suitable standard for the purity of drugs.

During the last quarter of the nineteenth century, the maturing sciences of analytical chemistry and physics rapidly came to be applied to the detection of adulteration. And special organizations, such as the Society of Public Analysts, emerged to cope with the complex scientific and legal problems encountered in the administration of English adulteration laws.

Facets of the complex phenomenon surrounding the control of drug adulteration in England remain to be explored, particularly the influence of English experience upon other Anglo-American countries.

Microfilm $9.15; Xerox $32.40. 721 pages.

HISTORY

HISTORY, GENERAL

HISTORY OF THE (HIGHER) EDUCATIONAL MOVEMENT OF THE WESLEYAN METHODIST CHURCH OF AMERICA.

(L. C. Card No. Mic 59-4043)

Charles Winthrop Taylor, Ph.D.
Indiana University, 1959

The Wesleyan Methodist Church was organized at Utica, New York, in 1843. This Church desired to provide education for its youth in a protected environment, to further the prosecution of abolition and reform, to provide a trained and loyal ministry, and to promote the welfare of the nation.

Their first educational attempt began in 1844, when the New England Conference opened an Academy at Dracut, Massachusetts. This operated only two years. Other abortive attempts in New York and Ohio never got fully under way.

The Michigan Conference of the Wesleyan Methodist Church was granted charters to operate Leoni Seminary, and Leoni Institute, at Leoni, Michigan, in 1848. In 1857, this school was rechartered as Michigan Union College. This school was transferred to Adrian, Michigan, and chartered as Adrian College in 1860. An attempt at joint operation resulted in its transfer in 1866, to the control of the Methodist Protestants.

The Illinois Conference opened Illinois Institute, at Wheaton, Illinois in 1852. Lack of financial support led to cooperation with the Congregationalists who rechartered the school as Wheaton College in 1860. An attempt by the denomination to operate a Seminary at Wheaton College in the 1880's, failed after a few years for lack of financial support.

The attempt of the Minnesota Conference to operate a school at Wasioja, Minnesota, resulted in financial failure when its supervision was not placed under the newly formed Wesleyan Educational Society.

Houghton College, Houghton, New York, was founded in 1883, as Houghton Seminary and Bible Training School. A college department was soon introduced, though not fully chartered until 1927. Accreditation by the Middle States Accrediting Association was achieved in 1935. This largest and only fully accredited Liberal Arts College of this Church has developed rapidly.

Wesleyan Methodist College, Central, South Carolina, had its beginnings in the Wesleyan Bible Training Institute, established in 1906, and rechartered in 1909, as Wesleyan Methodist College. Development was slow until the 1940's, when an extensive improvement program was launched. Since 1950, both the College and the Bible School have been accredited by accrediting associations.

Miltonvale Wesleyan College, Miltonvale, Kansas, opened as an Elementary School and a High School with a Theological Department in 1909. A College Department was introduced about 1915. In the late 1940's, an extensive improvement program was launched and led to a Class A rating for the High School and full accreditmemt as a Junior College by the Kansas State Department of Education.

Marion College, Marion, Indiana, originated through the agitation of the Indiana Conference for a central school. Property of the old Marion Normal Institute was purchased and the Fairmount Bible School moved to Marion as the Theological Department of the college in 1920. The college at its inception, operated as a four year Liberal Arts College, with a Normal School, Theological Department, and a High School. It operates today as a Liberal Arts College with a Division of Theology and Ministerial training, and is approved for the training of teachers.

These four colleges are under control of the Board of Administration of the denomination, although since 1955, more authority was vested in the Local Boards of Trustees.

Microfilm $4.65; Xerox $15.60. 361 pages.

HISTORY, ARCHAEOLOGY

BRITISH AND AMERICAN REACTIONS TO LAYARD'S DISCOVERIES IN ASSYRIA (1845-1860).

(L. C. Card No. Mic 59-3753)

Phillip Andrew Kildahl, Ph.D.
University of Minnesota, 1959

The impact of Darwin's work upon the thinking in the nineteenth century is well known. What is not so familiar is the effect of the findings of the archaeologist who, more than any other single contributor, provided society with facts that were too far reaching in their implications and

too disturbing in other ways to be admitted or even acknowledged. What resulted was much more than a mere battle of books; it bacame a veritable campaign of planned evasion on the part of the defenders of the orthodox views. In this dissertation we have introduced the twentieth century reader to Sir Henry Austen Layard. This man was the pioneer researcher in the field of Assyrian archaeology; he re-discovered the ancient glory that was Nineveh and inadvertently laid the ground work for the discovery, by others, of the Assyrian libraries which contained the literary prototypes of the Old Testament.

Up to this point of discovery, the work in Assyria was largely supported with enthusiasm by the theologians in England. Layard himself, in his written reports, was guilty of special pleading. He intended his remarks for the protestant ear of England and consistently appealed to emotional rather than to intellectual elements in his reading audience. When the full implications of the archeological finds became known to the theologians of England, the whole situation changed. Whereas before Layard had been lionized by English scholars, he now went into eclipse. His books and those of his successors were not condemned, but worse, they were ignored. The whole field of Assyriology became more or less suspect, and few scholars were hardy enough to enter into its precincts. Assyriology, as such, languished until the twentieth century; it has just recently emerged from oblivion, so to speak, once more into the light of day.

The initial chapters of the dissertation consist largely of a functional criticism of the early archaeologist and his methods. His unscientific and wasteful techniques are not condoned, but they are explained and justified on the basis of inexperience. Who, after all, was available to teach these men?

Layard was interested in the publicity and in the profits from the initial sale of his books. In this he was only human, but he went further and actually grandstanded outrageously for his audience. This caused embarrassment among scholars back home although Layard's work was too important to be ignored simply because of his personality.

The last chapter but one deals with the impact and threat to orthodoxy and how it was handled in England; the last chapter is concerned with the same subject and how it was handled in America. In England the defense of orthodoxy took on an aspect of frenzy, if not of hysteria, and pointlessness. Numerous articles fabricated upon a skein of fallacy appeared in the learned journals. Societies were hastily organized for the sole purpose of defending the faith against all and sundry factual and fanciful evils. After the initial storm of activity was over, the participants could not look with much pride upon their work, for it had all been done in heat and passion. Perhaps never before or since has so much intellectual energy been so fruitlessly dissipated.

In America the whole situation was different. The minds of the American intellectuals were preoccupied by more portentous matters, and it could be found that little impression was made by the news that so forcibly shook the British theologians.

In conclusion we try to explain why the impact was different in England and America, but discover that, except for the internal affairs in America having a profound influence upon the thinking of the people, there is no available answer. Microfilm $2.90; Xerox $10.00. 224 pages.

HISTORY, ANCIENT

THE FOREIGN POLICY OF THE ATTALIDS OF PERGAMUM.

(L. C. Card No. Mic 59-4536)

Roger Burnham McShane, Ph.D.
University of Illinois, 1959

Most historians of the Hellenistic kingdom of Pergamum have accepted without adequate criticism the views of various ancient historians who did not understand Greek problems in Asia Minor and who therefore minimized the influence of Pergamum during the century when Rome was becoming the dominant power in Asia Minor. Actually, the Attalid kings of Pergamum directed Aegean politics through the crucial wars of 200-189 B.C., governed most of Asia Minor from 188 to 133, and had a great influence in shaping Rome's later policies in Asia.

The Greeks along the Aegean and Propontine coasts of Asia, always greatly outnumbered by the "barbarians" around them, had long been accustomed to collaborate in trade agreements and for mutual defense and in making the diplomatic bargains with Persian and Hellenistic rulers which guaranteed the autonomy of their cities. Between 281 and 215 B.C. the first three Attalid rulers, while developing an independent kingdom around the city of Pergamum and fostering a reputation as benefactors of Hellenic culture, defended neighboring Greek cities against marauding Gauls and other "barbarian" aggressors. Attalus I (241-197) became hegemon of a Greek alliance, similar to the contemporary symmachia led by Macedonian kings, with both free and subject cities, and leagues of cities, looking to him for diplomatic and military leadership.

Aiming to maintain a balance of power with rival Rhodian and Macedonian symmachies, Attalus joined the Aetolian League and Rome in a war against Macedonia and Bithynia in 211-205 B.C. This bond with Rome was strengthened in the Second Macedonian War (200-197) when Attalus joined forces with the Rhodian symmachy, drew Rome into a coalition championing Hellenic freedom, and thus drove Philip V of Macedonia out of Greece, Thrace, and Asia Minor. Shortly thereafter Eumenes II of Pergamum (196-159) persuaded the Romans to send ships and troops to help Rhodes and Pergamum turn back Antiochus III of Syria, who was planning to seize control of Asia Minor and Thrace.

The peace terms with Syria (188) made Pergamum the strongest power of Asia Minor, with Rome accepting no territory or responsibility there. Through an enlarging Panhellenic coalition with Syria and Cappadocia, Eumenes II defeated two "barbarian" coalitions who threatened his allies, frustrated various Oriental uprisings, and kept the Asiatic Greeks prosperous. Meanwhile "isolationists" at Rome became increasingly hostile to Pergamum. Roman generals led a third anti-Macedonian coalition to victory over Perseus in 168, but the Senate treated Eumenes with suspicion thereafter. This Roman antagonism encouraged the Gauls and Bithynians to attack Pergamum again but Eumenes and his successor, Attalus II (159-138), maintained Greek supremacy and Attalid prestige in Asia Minor.

When Attalus III (138-133) died without heir, he willed the Pergamene kingdom to the Romans, hoping that they would undertake themselves the defense of the Asiatic

Greeks, which it was becoming increasingly difficult to maintain under the last Attalids. However, Rome immediately required aid from the allied Greeks to secure control of Asia Minor in 133-130, because a dangerous revolt of the native Asiatics, led by Aristonicus, broke out as soon as Attalus III was dead. From their earlier dealings with Pergamum, and from their experience after 133 in governing the former Attalid kingdom, the Romans learned the fundamental diplomatic principles which became incorporated in the policies by which they governed the Mediterranean world and protected Greek culture in Asia for several centuries. The eventual heir of the Attalids was Augustus, who provided leadership on a larger scale much like that which Attalus I and Eumenes II had exercised as hegemons in their Pergamene symmachies.

Microfilm $3.25; Xerox $11.00. 250 pages.

HISTORY, MEDIEVAL

EDUCATION AND STATE SERVICE DURING THE PERIOD OF THE GERMAN SAXON EMPERORS, 919-1024.

(L. C. Card No. Mic 59-5012)

Reinhard Wittke, Ph.D.
University of Michigan, 1959

This study is concerned with the relationship between education and state service during the period of the German Saxon emperors. Treated are the academic requirements for state service, the role of the state in education, the nature of the program of study, and the institutions concerned during the time under discussion. This is presented against the background of the educational tradition and state service prior to the Saxon era. The first six chapters analyze both of these from the time of the Greek city-state through the Carolingian Renaissance. The results of this preliminary work set the pattern for the study of the Saxon period.

It becomes apparent that the educated man in the Greek city-state, and in Hellenistic Rome was the man of state. This is clearly set forth by the writings of Isocrates, Cicero, and Quintilian. The future statesman received a broad training in grammar and rhetoric, both providing a wide literary background, practice in style and eloquence, as well as preparation for politics and law. The Christians adapted the techniques of pagan studies to their own purpose, the salvation of man; and yet preserved the concepts of Ciceronian ethics and politics and duty to the state. In the Merovingian era education of a sort existed in the Church and at the royal court. Learning, however, in this epoch was based upon a diluted trivium or the practical experience provided at the court; even though education reached its nadir some education for government service remained.

Charlemagne continued the Church reforms of the Irish and Anglo-Saxon missionaries, and successfully instituted an educational reform which resulted in the Carolingian Renaissance. The royal court and particularly the palace school became the centers for the new education, which then spread to the monastic and episcopal schools. The trivium now was basic, with grammar considered the most important subject. Though considered a handmaiden of theology the trivium nevertheless was instrumental in preparing personnel for government service.

It is this Carolingian tradition that was inherited by the Saxon rulers. While the tradition was continued there were, however, some important changes and developments. A definite pattern for developing the civil servant emerged. Qualifications became more rigid; birth and education became more and more important. Certain schools were given preference over others. It was most difficult to receive an appointment to the chapel and chancellery, the main centers of state administration, without first having received an education in the episcopal or monastic schools. Appointment to these institutions assumed great importance since service in the chapel and chancellery became the main path to achieving high Church office. Chapel and chancellery served as practical finishing schools for state service.

Most significant, however, was the re-emphasis on rhetoric which took place with Otto III and Gerbert of Aurillac. Under them there was a return to the educational tradition of antiquity. Rhetoric once more was pressed into service to produce the ideal--the perfect orator, the good man and wise, skilled in speaking. Thus, the educated man of this, the later Saxon period, like the educated man of antiquity, was a man of state, though he now served Church and state alike. Indeed, with Gerbert there was a genuine revival of Ciceronian concepts in the realms of education and state service.

Microfilm $6.05; Xerox $21.00. 474 pages.

HISTORY, MODERN

NATHANIEL WARD, PASTOR INGENIOSUS, 1580?-1652.

(L. C. Card No. Mic 59-4493)

Mary Janette Bohi, Ph.D.
University of Illinois, 1959

As one studies the life of Nathaniel Ward he becomes aware that he is meeting a Puritan of extraordinary ability and accomplishment; yet, when he has finished the study, he finds that the basis for all that was unusual about Ward is the fact that he was fundamentally an ordinary person who tried to follow the dictates of his heart while being unwillingly squeezed into the mold of a changing world. He made significant contributions without pioneering, and what at first seems an innovation turns out to be a very natural manifestation of all that made up his life. It was so with his famous book, The Simple Cobler of Aggawam in America. What was puzzling in the Cobler to observers who thumbed through the prosaic literature of seventeenth-century America was only the author's legitimate amplification of the Elizabethan heritage. Likewise, the apparently liberal tendencies in the Body of Liberties were no more than the constitutional application of parliamentary law to the needs of a primitive society bound by the iron rule of

magistrates and elders. Even in his pamphleteering Ward met the adversary with arguments which had been a part of him from his youth and which he refused to unravel for the sake of binding an enemy.

Having decided to give up his budding career as a lawyer, Ward became rector of Stondon Massey in Essex after returning to England from the Continent. His seven years at Stondon were interrupted by the threats of William Laud, and in 1634 Ward found himself among the ejected ministers of the New World. In New England he became involved in political and legal affairs; but his program, based upon the principles of constitutional monarchy as he had seen it work in the land of his youth, made him unpopular with the Bay fathers. It is to Ward's credit that his code of laws, inimical as some of his precepts were to the hopes of the magistrates, was adopted and became a pattern for successive codifications.

When Ward returned to England after a twelve-year sojourn in Massachusetts, he was again lost among his countrymen. His principles drove him to the Presbyterians and his conscience made him their mouthpiece during the days of the Second Civil War, but he did not take the Covenant as a party man. He wrote strenuously but was unable to comprehend the changed political status brought about by the Army and the Independents. He represented the generation of conservative Puritanism which passed into the background during the reign of James I, when for the Puritans the issues of the prerogative of the crown and the purity of the church merged.

Nathaniel Ward deserves a biography not because he was a great man but because he is an example of the many individuals whose contributions have been forgotten in our rush to capture the celebrities of history. Both England and America owe a debt to Ward, and it is fortunate for his memory that historians have almost completely removed the prejudice against the Puritan fathers. It is to be regretted that more records dealing with Ward's life and work do not exist; however, it is the opinion of this writer that there need be no serious gaps in our understanding of Ward and his generation if what is available is studied with care. Ward was one of the most thoroughly educated and experienced men of the seventeenth century, and it will be to our advantage to remember this Elizabethan Puritan and first minister of Ispwich, Massachusetts as a Pastor Ingeniosus.

Microfilm $4.95; Xerox $16.60. 386 pages.

IGNACIO COMONFORT: HIS CONTRIBUTIONS TO THE MEXICAN REFORM, 1855-1857.

(L. C. Card No. Mic 59-4712)

Ray Francis Broussard, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Lewis U. Hanke

Ignacio Comonfort, born into the turmoil and chaos of post-revolutionary Mexico, spent his early manhood observing the never-ending cycle of revolution and counter-revolution, and emerged with the conviction that little was to be gained from a mere repition of the pattern. He developed the belief that violence bred violence, and excesses of the victors caused such resentment they almost automatically insured a counter-revolution.

Comonfort received the opportunity to put his ideas into effect when he joined the Revolution of Ayutla in 1854, against the Santa Anna dictatorship. He introduced into the guerrilla fighting activities of the rebels a semblance of honor and order. Prisoners were spared, and civilians were promised payment for supplies and money forcibly taken from them.

With the Revolution over and Santa Anna successfully driven from the country, Comonfort emerged as the strong man of the movement. He settled the disputes of the conflicting revolutionary chieftains in order that the forces of Ayutla could present a united front to the country when the provisional government was established.

The Álvarez interlude (October--December, 1855) served to convince Comonfort of the truth of his convictions that a successful revolution had to be careful not to take revenge upon the defeated enemy, nor to take advantage of its position of temporary superiority to impose its political program upon an unwilling country. He believed that if such a plan were followed, the reaction would result in a counter-revolution, and the old cycle would begin once more.

Appointed president by the retiring Álvarez, Comonfort worked diligently to put his ideas into effect. He organized a government which although liberal in direction and composition, favored no political party or faction. Attempting to respect the sensibilities and interests of the defeated conservatives, Comonfort challenged the extreme elements of his own liberal group, and succeeded in staving off the more extreme reprisals and radical changes they contemplated. Then, while holding back the reactionary groups trying to overthrow the government, Comonfort allowed the Constituent Congress to meet and draft the famous Constitution of 1857, which incorporated numerous political, social, and economic reforms needed to make Mexico a modern, democratic nation.

During the two years he served as president, Comonfort went ahead with his own program of slow, gradual, and gentle reforms, which, however, resulted in a growing reaction on the part of the extreme conservatives who particularly disliked his anti-clerical moves and the separation of church and state incorporated in the Constitution of 1857. Eventually, these reactionary conservatives were to discredit Comonfort's administration and to diminish his position in the affections of the people of Mexico. Comonfort failed in his policy to erect a non-partisan government dedicated to a slow, moderate reform.

Not all of Comonfort's reforms were wiped out in the debacle, however, for some of his economic and educational changes remained to continue in force until the present day. Some of the schools founded by Comonfort are still operating. The improved postal system, the beginnings of a modern communications network, and the establishment of the metric system of weights and measures are all examples of his progressive reforms which survived him and his age.

Microfilm $3.70; Xerox $12.60. 288 pages.

JOSEPH WARREN: PHYSICIAN, POLITICIAN, PATRIOT.

(L. C. Card No. Mic 59-4498)

John Henry Cary, Ph.D.
University of Illinois, 1959

Joseph Warren, born May 30, 1741 at Roxbury, Massachusetts, the son of Joseph Warren and Mary Stevens Warren, graduated from Harvard in 1759 and studied medicine under James Lloyd. Warren began practice during the smallpox epidemic of 1763, and became a successful doctor and teacher, training many men who achieved distinction in medicine and served in the Revolution, including his brother John.

Warren entered public affairs by opposing the Stamp Act, and was instrumental in forcing the recall of Governor Francis Bernard. With Samuel Adams and others, he opposed British rule and the domination of the Massachusetts executive and judiciary by the Conservative Party of Thomas Hutchinson. An attempt to create an opposition party had little success outside of Boston because of the nature of legislative elections and the control of patronage by the Conservatives. But by appealing to the growing nationalism, the Warren-Adams party shaped Massachusetts policy until 1768.

In February 1768, Warren attacked the Conservatives in an article signed "True Patriot" and, in June, assumed leadership in the Liberty incident, which was designed to test the power of the Commissioners of Customs. As a result, British troops were sent to Boston, and, in September 1768, Warren and Adams failed to persuade Massachusetts to resist the landing of these troops. After this their strength declined until 1773, because of the economic prosperity of the period and their part in the Boston Massacre affair. They tried to keep party spirit alive by instructions to Boston's representatives, often written by Warren, and speeches commemorating the Massacre, such as that delivered by Warren in 1772.

In late 1772, Warren served on the Boston Committee of Correspondence and wrote an important statement of grievances which helped revive party strife. He continued to serve as grand master of Ancient Freemasons in America, and the connection of the Masons with the tea incident suggests that Warren may have led the tea party. The first Boston opposition to the East India Company Act was taken under his leadership, and the English Ministry considered arresting him on treason charges. In 1774 he authored the Solemn League and Covenant, providing for nonconsumption of British goods, and the Suffolk Resolves which pledged the Continental Congress to defensive war.

Warren also led town committees in 1774, urged the calling of a Provincial Convention--of which he was elected president--, and served on the important Committee of Safety. After warning the colony of the march of the British, he fought in the battle on April 19th. During the next two months he worked to strengthen the army, to gather supplies, and to direct the civil government. It was because of Warren that Benedict Arnold was commissioned to take Fort Ticonderoga. Before his death on June 17, 1775, Warren was chosen major general in the Massachusetts army, but died at Breed's Hill fighting as a common soldier.

Warren's biography is of interest in itself as indicating the significant roles which he played in Massachusetts medicine, colonial politics, and the American revolutionary movement. He ranks with Samuel Adams as one of the most important revolutionaries in Massachusetts, a fact little noted by historians. Further, his life story aids in understanding the causes of the revolution in that colony. Warren reflected the growing nationalism and desire for home rule of his people, but he saw as many did not, the need for a strong political party. His continued political agitation during a period when imperial issues were not prominent indicate that his party was also interested in breaking the political power of the Conservative Party in Massachusetts, which was so inextricably related to British imperial rule. Microfilm $4.75; Xerox $15.80. 369 pages.

THE MISSION OF CHARLES DENBY AND INTERNATIONAL RIVALRIES IN THE FAR EAST, 1885-1898.

(L. C. Card No. Mic 59-3512)

John William Cassey, Ph.D.
University of Southern California, 1959

Chairman: Professor Van Alstyne

The fundamental factors of American foreign policy in China during most of the nineteenth century were to be found in the treaties signed with that country. One of these factors was Chinese exclusion. This was to be a constant source of friction in Sino-American relations. It was to have definite effects on American commercial expansion in China. In the opinion of most commercial interests in the United States and China, exclusion was detrimental to American commerce in the Far East. This view was also held by Minister Denby at Peking, who consistently sought to remove this obstacle to commercial expansion in China.

Another problem faced by the American minister was that of missionaries and the constant riots against them. Missionaries consistently sought the support of their governments against the Chinese when riots occurred. Minister Denby viewed the missionaries as pioneers of American commercial expansion in China. Consequently, he constantly advocated their support by the American government as a means of exploiting the potential growth of the Chinese market. Missionaries in China also received the support of the commercial classes in the United States and China. On the other hand, the missionaries in turn supported the business groups in their efforts in China. With regard to missionaries and their protection, Denby advocated a cooperative policy with the other powers in China. His purpose was twofold: first, to bring about an end to the riots, which were a hindrance to trade, and, second, to prevent the other powers in China from using the riots as an excuse to partition China.

In view of the active support given by the other foreign powers—England, France, Germany, and Russia—to their commercial interests in China, Denby advocated a more active policy by the United States. He pointed out that it was very difficult to secure economic benefits without assuming some political responsibilities. While in China, Denby consistently strove to interest American commercial firms in the possibilities of the Chinese market. This was especially true during and after the Sino-Japanese War in

1894. He played an important role in the early attempts by Americans to secure concessions in China. Denby attributed these early failures to the lack of a more organized effort by commercial firms in America. He also blamed the American government for its lack of support. His recommendations were not to be given serious consideration 1898. It was at this time that strong and well-organized groups were able to convince the American government of the necessity of its support in their plans in China.

Denby viewed the partition of China as a great threat to American interests in the Far East. For this reason he recommended a more active policy by the United States to prevent the dismemberment of the Chinese Empire. An apathetic policy by the American government was especially dangerous in view of the activities of the other powers in the Far East. To the American minister, Americans should have viewed the Pacific as an area of commercial growth. In his opinion, the United States was well situated to play a decisive role in the affairs of the Far East. The failure of the American government to realize this was evident in its policy of independent inaction.

The failure of the American government to follow to some degree its minister's recommendations did not detract from their significance. His ideas and recommendations were to be adopted in 1898 after his departure from China. The active interest manifested in the Far East by the American government and the commerical firms in the United States after 1898 vindicated his views and efforts.

Microfilm $4.10; Xerox $13.80. 319 pages.

THE CONTRIBUTIONS OF GEORGE W. NORRIS DURING HIS SERVICE ON THE UNITED STATES SENATE JUDICIARY COMMITTEE.

(L. C. Card No. Mic 59-4386)

Jerome Leslie Clark, Ph.D.
University of Southern California, 1959

Chairman: Professor Kooker

This dissertation is an evaluation of the work of George William Norris on the Senate Judiciary Committee with relation to his major interests during that service, namely, in the fields of legislation and individual rights. The subject is treated topically with emphasis on Norris' attitudes, opinions, and proposals in areas such as the constitutional amendment process, the electoral process, labor legislation, short sessions, the lame duck problem, judicial reform, the integrity of the Senate, civil liberties, and the confirmation of executive appointments.

George Norris was a member of the Senate Judiciary Committee from 1919 to 1942. His major contributions to the work of that committee were made during his chairmanship from 1926 to 1933, and the second most productive period followed his relinquishment of that office. Concurrent responsibilities as chairman of the Committee on Agriculture and Forestry before 1926 made those years less fruitful than the latter two thirds of his Senate Judiciary Committee service.

Two important legislative proposals of Senator Norris were accepted and passed while he was on the Judiciary Committee and constituted his most significant successes in the field of legislation during that period. One, the Norris-La Guardia Act, outlawed yellow dog contracts and closely restricted the use of injunctions in labor disputes. The second, the Twentieth, or Lame Duck Amendment, abolished Congressional short sessions, moved Presidential inaugurals from March 4 to January 20, and cut down the interim between Congressional election and seating from thirteen months to two.

Several of Senator Norris' proposals were rejected, including abolition of modification of the electoral college, direct election of President and Vice-President, changing the constitutional amendment process, and numerous judicial reform measures. His defeats in legislation were far more numerous than his successes.

Senator Norris' interest in maintaining the liberties of individual citizens and the integrity of democratic institutions led him to oppose fraud, exploitation, or dishonesty wherever he detected them. He was as concerned with championing the rights of one citizen, such as Frank J. Carlson, as in castigating the methods used in the election of William S. Vare to the Senate, or condemning the machinations of the power trust.

Opposed to partisan politics and suspicious of the motives of corporations and men of great wealth, Norris fought against senatorial confirmation of executive appointees whose previous associations had been with the rich and powerful. He felt these contacts made men unsympathetic to the needs and aspirations of the common man. Norris' judgment was sometimes misled by these convictions, as proved true in his opposition to the Supreme Court confirmations of Charles Evans Hughes and Harlan Fiske Stone.

Norris' intensity occasionally caused him to lack a saving sense of humor when his idealism was thwarted by political realities. Moods of melancholia sometimes followed such defeats. The most serious depression followed his November 1942 electoral defeat, and probably contributed to his death on September 2, 1944.

Senator Norris' integrity was never questioned. He rigidly applied the same standards of justice and individual right to public servants that he applied to his own life. His inflexibility in the espousal of liberal ideals made him one of the leading American liberals. It is the purpose of this dissertation to examine Norris' application of these ideals to his work on the Senate Judiciary Committee.

Microfilm $4.10; Xerox $13.80. 320 pages.

THE ROUMANIAN PROBLEM IN ANGLO-TURKISH DIPLOMACY, 1821-1824: BRITISH REACTION TO THE WALLACHIAN REVOLT.

(L. C. Card No. Mic 59-4001)

Radu Radu Florescu, Ph.D.
Indiana University, 1959

This study is an attempt to interpret the revolution of 1821 and its sequel in the light of hitherto neglected British documents, and, incidentally, provides an introduction to the problem of the Russian Protectorate in the Danubian Principalities which palyed a significant role in the history of Anglo-Turkish relations.

The significance of this re-evaluation rests upon two considerations: first, in the absence of reliable foreign sources and because of the paucity of native documents, British dispatches serve as an important documentary source for the study of Roumanian History in the period coincident with the reestablishment of native rule, and second, these documents are now being exploited by Communist historians for propagandistic rather than genuinely historical purposes.

Although official relations between the Principalities and the Great Powers have often been sketched, the origins of the British consulate have not so far found a historian. In tracing the story of these origins, I have attempted to round out an obscure episode, to clear up a few ambiguities, and to rectify some small errors and to assert the importance of the role of British agents in the history of the Principalities.

British documents are particularly valuable for the study of the Wallachian uprising of 1821 in both its domestic and its diplomatic aspects; for its domestic history because the other members of the consular corps at Bucharest fled during the four-months' crisis; for its diplomatic sequel at Constantinople because it was chiefly upon Ambassador Strangford that the burden fell of devising a solution which would avert a Russian occupation and ultimately a Russo-Turkish war.

In the revolt's domestic aspect British documentation provides a basis for the reinterpretation of the controversial relationship between Vladimirescu and Ypsilanti and enables us to reconcile traditional with more recent views. They also provide justification for considering this period, including its sequel of Moldavian activity on Transylvanian soil, as an ideologically fruitful episode marking the birth of Roumanian nationalism.

In the revolt's diplomatic aspect, the crisis of 1821-1824 at Constantinople raises the problem of the Principalities to international status. For the reintroduction of native rule that resulted from Vladimirescu's uprising could not long survive Russian opposition without the support of the Western Powers. That support was not forthcoming but Roumanian interests were well served by Ambassador Strangford, whose full contribution has never been recognized. The merit of Strangford's diplomacy lay not so much in the intricacy of his demarches, in the methods he used, or even in the solution worked out; it is rather to be found in the fact that he displayed an interest in the Principalities and had a solution to offer at a time when his superiors had none. By virtue of this interest he temporarily averted a Russian occupation of Moldavia and Wallachia. Microfilm $3.10; Xerox $10.60. 237 pages.

THE EFFECTS OF THE COUNTER-REFORMATION UPON ENGLISH CATHOLICS, 1603-1630.

(L. C. Card No. Mic 59-3106)

Sister Joseph Damien Hanlon, C.S.J., Ph.D.
Columbia University, 1959

This study of the impact of post-Tridentine movements upon English Catholics was made through six biographical vignettes, illustrating as many diversified factors as possible: geographical locations, classes of society, public and private figures, priests and laymen, types of Catholics and occupations. The tolerant attitude of the early Stuarts provided a favorable climate for the spread of the Counter-Reformation. Relaxation of penal statutes made possible easier communication with English seminaries abroad, freer licenses to travel to Catholic centers and brought an increase of priests working in England, especially the Society of Jesus.

Dorothy Lawson of Newcastle-upon-Tyne highlighted the development of active Catholic centers in the North and illustrated the importance of local tolerance and neighborly good-will. Mrs. Lawson established at her home a Catholic mission which Father Richard Holtby, S.J., Superior in the North, made his headquarters. Here, under a series of Jesuit chaplains, the full liturgy according to Tridentine reforms was carried out. Retreats for Jesuits were held annually and a library of Counter-Reformation literature was established. Dorothy Lawson's children were educated in English Catholic schools abroad, many of them later entering Tridentine religious communities. Most significantly, at her death, Mrs. Lawson was accorded a public funeral in the Catholic rite by permission of local authorities.

Sir Tobie Mathew, son of the Archbishop of York, like many sons of the gentry, obtained a license to travel into Counter-Reformation countries in search of excitement and out of curiosity. At Rome, Tobie visited Robert Persons, S.J. and frequented Jesuit Churches in Florence to hear sermons and attend devotions. Converted to Catholicism, he publicly announced his affiliation upon his return and was imprisoned briefly. Released into banishment, he spent nine years abroad, and was secretly ordained at Rome. Tobie became a noted translator and writer of Counter-Reformation works. An accomplished courtier, his religious connections proved invaluable in the King's Spanish marriage negotiations. He was recalled home by James and rapidly rose to favor at Court as a member of the new, fashionable, Catholic intellectual elite.

John Percy, S.J., yeoman, convert and graduate of Douai-Rheims and the English College, Rome, entered the Society at Rome. Sent on the English mission, he was, with Father John Gerard, chaplain to the vaux and Digby families but managed to escape punishment in the Gunpowder Plot. Although he was imprisoned on several occasions, he nonetheless enjoyed considerable freedom of movement and converted several hundred in all classes of society. His conversion of the Countess of Buckingham was the occasion of a famous public debate with notable Divines, especially Dr. Laud. An outstanding controversialist, Father Percy was ultimately given complete freedom under royal protection until his death.

Counter-Reformation art forms are evident in the work of Richard Dering and Inigo Jones. Dering had studied music under Gabrieli and Monteverdi and utilized the new musical forms as organist to the English Benedictine nuns at Brussels and to Queen Henrietta Maria. He composed and published considerable sacred music in the Tridentine style, which became popular with English Catholics and Protestants. Though of a luke-warm, if not doubtful, variety of Catholicism, Inigo Jones represents, with Ben Jonson and the Beaumonts, the effect of Mediterranean religious and secular influences. The main impact of his study of Trident architecture at Rome is best seen in the Chapels Royal and Court Masques.

Finally, Edmund Bolton illustrates the accepted position

a scholar could enjoy, even when a known Catholic, in a circle of tolerant intellectuals, like William Camden and Sir Robert Cotton. Bolton became acclaimed in his own day for his proposed Academy Royal and his works on history and heraldry. The quiet, unmolested aspect of much of Catholic England under the Stuarts is summed up in his life. Microfilm $5.00; Xerox $16.60. 390 pages.

THE NEGOTIATIONS FOR A TRIPLE ALLIANCE BETWEEN FRANCE, AUSTRIA, AND ITALY, 1869-70.

(L. C. Card No. Mic 59-4632)

Douglas William Houston, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Lynn M. Case

The unsuccessful negotiations for a triple alliance between France, Austria, and Italy prior to the Franco-Prussian war have been freely speculated upon, most often in a highly partisan fashion. After the war they became an issue in the internal politics of Austria and France and initiated a dispute which raged intermittently for forty years. Despite the opening of the European archives and publication of European diplomatic documents in recent years, the subject has not yet been treated from the viewpoint of more than one country. This study is based on research in the Haus-, Hof-, und Staatsarchiv, Vienna, and the archives of the Ministère des Affaires Etrangères, Paris, as well as on published material.

During 1867-68 France and Austria sought to end their diplomatic isolation by drawing closer together. The French hoped for an anti-Prussian alliance, but the Austrians, for reasons of internal politics, favored an alliance directed toward Eastern Europe. In an effort to reconcile this conflict of interest Italy was brought in to make a third party in negotiations for an offensive and defensive alliance. Between March and May 1869 a series of draft treaties was devised, but each project was discarded because one or another of the parties feared that the treaty would be unacceptable to public opinion. The negotiations finally broke down altogether over French refusal to evacuate Rome.

In September 1869 a substitute for an alliance was improvised in the form of letters exchanged between the sovereigns, in which they promised to forswear negotiations with any outside parties, and it was understood that the negotiations would be resumed when the internal political situation in the three countries was more favorable. In the spring of 1870 France and Austria undertook military conversations, and the Austrians hinted that they were now willing to fight a war against Prussia if the circumstances were favorable.

Despite the fact that Napoleon III and Victor Emmanuel regarded a treaty as "morally signed," no alliance was concluded when the war came in July 1870. French vigor in meeting the Hohenzollern crisis made it extremely difficult for Austrian and Italian statesmen to justify intervention in behalf of an apparent aggressor. Even so, Austria and Italy sought to aid France until the last possible moment. Negotiations for an Austro-Italian treaty aimed at eventual intervention were ended by French military reverses, and an attempt to form a League of Neutrals to mediate the conflict was thwarted by the hostility of Russia and the non-co-operative attitude of Great Britain.

France's apparent aggressiveness and her unwillingness to evacuate Rome, as well as Russia's threatening attitude toward Austria, were all important factors in preventing the conclusion of an alliance in 1870. Underlying the whole course of negotiations was the fear of public opinion. From the beginning the alliance was the work of the sovereigns and their aristocratic advisers. The negotiations were carried on not through normal diplomatic channels but by personal intimates of the three sovereigns. All of the participants were anxious to conclude an alliance even after the war had begun but feared the hostility of public opinion. The proposed triple alliance of 1869 was thus an attempt at a cabinet alliance at a time when conditions in the three countries no longer made a cabinet alliance possible. Microfilm $4.70; Xerox $15.80. 367 pages.

THE UNITED STATES AND SWITZERLAND IN THE NINETEENTH CENTURY.

(L. C. Card No. Mic 59-3532)

Heinz Karl Meier, Ph.D.
Emory University, 1959

American-Swiss relations in the nineteenth century contained a strong mixture of ideological and practical motivations. Both countries had a number of practical reasons to enter into close relationship. Switzerland's main interest during a large part of the century was the protection of its steady flow of emigrants. The establishment of a considerable network of consulates, begun in 1822 with the creation of consulates at New York and at Washington, was inspired by the desire to assist Swiss individuals and merchants and to protect their interests, as were the first treaty negotiations. These led to the convention of 1847, which concerned the inheritance of property of deceased Swiss in the United States. Another reason for the Swiss desire to be on good terms with America was the fact that throughout the century the great nation across the ocean increased in importance as a market for Swiss products, especially those of the various textile manufacturers.

The practical reasons for the American desire to develope intercourse with Switzerland were less obvious. The exports to Switzerland of such raw materials and foodstuffs as cotton, tobacco, rice, and later canned meat and dried fruits, were of minor importance for the United States economy, and the several hundred American travelers who visited Switzerland each year hardly needed a diplomatic agent to look after their interests. Yet it was the United States and not Switzerland which took the initiative in negotiating a general treaty of friendship and commerce, by sending Special Agent A. Dudley Mann to Bern in the fall of 1850. The United States also established a legation at Bern in 1853, and maintained it throughout the century, although Switzerland did not reciprocate until 1882.

The motives for these American actions were mainly ideological. In the late 1840's Switzerland passed through a period of internal crisis and emerged from it with a completely new constitution partly modeled after the American. In 1850 it was the only democratic country among a

host of reactionary and hostile European autocracies and deserved therefore all the moral support the United States could give it. All the early American envoys to Switzerland repeatedly emphasized this fact and implored their government to be patient and lenient with Swiss peculiarities. The Swiss appreciated this attitude and allowed the first United States minister to Switzerland, Theodore Sedgwick Fay, to exert an influence which far surpassed the ordinary measure, for example in such matters as the treatment of Hebrews and the Neuchâtel affair. The wave of emotional attachment reached its climax during the Civil War when large parts of the Swiss public and many government officials took side openly with the Lincoln administration, the preservation of the union, and the emancipation of the slaves. This enthusiasm cooled off somewhat in the following decades, but feelings of friendship and ideological kinship permeated all subsequent dealings of the two countries.

The outstanding diplomatic achievement of the century was the Convention of Friendship of 1850. Ratified in 1855, after five years of protracted negotiations, it regulated citizenship rights, the inheritance of property, consular service, extradition and commerce. Almost exactly fifty years passed before the commercial clauses of the convention of 1850 were abrogated and its extradition part was replaced by a new extradition treaty. A series of postal conventions excepted, all efforts to conclude agreements on such matters as arbitration, naturalization, and the protection of Swiss citizens by American officials in countries where Switzerland had no representation, remained fruitless. But these unsuccessful treaty negotiations did not diminish the cordiality of American-Swiss relations, for often each regulated matters to the other's satisfaction by unilateral action.

Microfilm $3.35; Xerox $10.60. 259 pages.

JUSTICE JOSEPH STORY: A POLITICAL AND CONSTITUTIONAL STUDY.

(L. C. Card No. Mic 59-4378)

R. Kent Newmyer, Ph.D.
The University of Nebraska, 1959

Adviser: James L. Sellers

The career of Mr. Justice Story--extending as it did from the Jeffersonian revolution of 1801 to the eve of the Mexican War--paralleled economic and political changes of the greatest magnitude. These years saw the United States sever the last vestiges of dependence upon England and the Continent, and, in a surge of expansion and exploitation, lay the basis for future economic preeminence. The effects of the concomitant changes in economic organization and social structure were permanent and far-reaching. Political developments were of no less significance. With the extension of the franchise, the multiplication of elective offices, and the perfection of the representative machinery of political parties, the common man came into his own. If he did not dictate government policy, he did successfully demand that his needs, wants, and passions be courted.

To trace the reaction of Judge Story to these changes is not to chart the reaction of an ordinary or a passive observer of the historical scene. Sensitive and introspective in nature, and absorptive and comprehensive in intellect, he imbibed deeply of the age, and, in a varied legacy of formal and personal writings, left a solid and perceptive account of events. But Story was not simply a witness to history. He moved, at a pace commensurate with his ambition and ability, quickly into a position of leadership in the Massachusetts Republican party. As a member of the state House of Representatives, and later as a speaker of that body, and as Republican Representative to the Congress of the United States in 1808-1809, during the critical embargo crisis, he played an active and determining part in events. In 1812, he was appointed Associate Justice of the United States Supreme Court and remained engaged in the duties of that office until his death in 1845. In addition to his judicial duties, which he performed with singular learning and devotion, he served as Dane Professor of Harvard Law School. Under his guidance, that school became the foremost in the nation, and Story's influence and reputation increased correspondingly. From his lectures at Harvard emerged a series of monumental legal treatises on nearly all branches of jurisprudence. These works alone would entitle Story to a position of authority among American legal publicists. In addition to these various activities were extensive and influential extra-judicial services to the Whig party and a vast and never unattended network of personal relationships. Perhaps more than his notable contemporaries--Marshall, Webster, Kent, and Clay--Story occupied a position enabling him not only to witness the inner workings of government, but also to shape opinion and influence policy.

It is the aim of this study to delineate more precisely the nature and character of Judge Story, to chart his reaction to the changes of his time, and, most importantly, to discern and evaluate the constitutional and political thought which he evolved in response to those changes.

Microfilm $4.95; Xerox $16.60. 387 pages.

THE HISTORY OF THE LYNCHBURG FOUNDRY COMPANY, 1896-1930.

(L. C. Card No. Mic 59-4244)

Henry Dart Reck, Ph.D.
University of Virginia, 1959

The study begins with a history of plow design and manner of manufacture in Virginia from colonial times to 1900, and also with an account of the first three generations of the McWane family in the Virginia iron trade. Beginning with James McWane, Scottish immigrant and millwright who settled in the Shenandoah Valley in the 1820's, the McWanes went on to manufacture plows and other agricultural implements. In postbellum Virginia they progressed from iron casting on a small scale in Wythe County to establishment of the Lynchburg Plow Company, Lynchburg, Virginia in 1896. Capitalized at only $25,000, the firm was destined after a long trial period to evolve into a flourishing foundry company casting products for the farm, cities and industries.

The first seven years of the plow firm (1896-1902) reflect the hardships of organization in management, company financing, and markets and sales. Records of the Company give an intimate picture of the personal

side of the business, particularly the strong figure of Henry E. McWane.

Beginning his career in the family's small foundry in Wythe County, McWane in the 1880's had become manager of the Glamorgan Pipe and Foundry Company of Lynchburg, where he cast the first Bonsack cigarette machines and introduced pit-cast pipe manufacture. The Glamorgan Company, like so much Southern industry in this period, was owned by Northern capital and absentee directors. One clearly sees in the career of McWane how managerial discord arose at Lynchburg from the badly-snarled lines of Northern executive control.

Striking out on his own, McWane became president of the struggling Lynchburg Plow Company in 1902, and reorganized it as the Lynchburg Foundry Company with local financing. The Company immediately embarked on a program of expansion. It added a pipe-casting works to the Lynchburg plant, developed a special-casting works, and doubled the Company's foundry facilities by purchase of a bankrupt but modern plant at Radford in southwest Virginia. Highly successful in these moves, McWane attempted to expand the Company further, chiefly in the sharply competitive Alabama field. These distant, expensive ventures came to nothing. They so overburdened the officer and financial structure at Lynchburg that the Company withdrew from Alabama, thereafter confining itself to manufacture in Virginia. There it found the economic medium in which it most profitably functioned.

In the period 1915-1919, the history of the Company shows in fine the experiences of most producers in the American iron and steel industry, for example, the pick-up of business in 1916 through supplying cast-iron pipe for a munitions plant (DuPont) which manufactured powder for the Allies at war; the war-boom of production in pipes, plows and special castings for America's own military effort; the post-war drop in market, accompanied by labor's aggressive stand for better wages, hours, and working conditions. The Company countered labor's efforts to unionize its shops by building up its own enlightened programs of workmen's insurance and committees of mediation.

The First World War gave the Company confidence in itself as an independent iron-manufacturer; in 1926 it declined to merge with competitors. The Company chose to work out its industrial life alone, which thus made it imperative that in price and quality its products should match or excel all in the field.

Despite depressed conditions of the iron market in December 1929, the Company moved to install the most modern mechanical devices for increased production of pipe and special castings. Though the cast-iron market fell off in the 1930's, the Company continued to keep up with the progressive mechanization of foundry practice.

Throughout, this study shows alertness of the Company to developing uses of metallurgy in its iron manufacture. And it led pipe producers in observing uniform standards of size and quality, as earnestly requested by water and gas companies serving urban and industrial areas.

Much attention is given in this study to the purposeful maintenance of harmonious personnel relations, which the Company deemed as vital to success as keeping up with new technologies in the American cast-iron trade.

Microfilm $3.90; Xerox $13.20. 302 pages.

THE MASSIES OF VIRGINIA: A DOCUMENTARY HISTORY OF A PLANTER FAMILY.

(L. C. Card No. Mic 59-4735)

Oliver Morris Refsell, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Barnes F. Lathrop

This study deals with the papers and history of Major Thomas Massie (1747-1833) and his descendants in Virginia from the time when Major Massie's surviving papers began about 1780 down to the death of his youngest son's fourth wife in 1889, when the plantation records come to an end. The history and fortune of the family are presented by editing their available records. The documents are either transcribed in full, summarized, condensed into tables, or calendared at the ends of the chapters.

The papers from 1789 to 1820 are largely those of Major Massie, first as he tried various places in search of a suitable location, then at the permanent home which he finally found in the valley of the Tye River on the east slope of the Blue Ridge Mountains in Amherst County in 1803. A large group of letters in this period are from a succession of commission merchants as Major Massie moved from place to place. The topics discussed include details of the sale of flour, wheat, tobacco, and the price, type, and quantity of goods furnished Major Massie. From 1803 to 1820 he built up his estate and provided his three sons with plantations. From 1820 to 1833 the correspondence is mostly Major Massie's, while the other records are primarily those of his youngest son, William Massie (1795-1862). Through the records of William it is possible to trace the expansion of a new plantation system, the development of his methods in handling slaves and his practices in the rotation of crops (tobacco, corn, wheat, and hay), which were advanced for his period. From 1833 to 1862 the papers relate mostly to William Massie's completion of his four-plantation system, his struggles to make slave labor profitable, and his family affairs. His success is highlighted by the complete failure of his son, Thomas James Massie (1817-1877), who caused his father much worry and expense. From 1862 to 1889, William's widow, Maria C. Massie (1814-1889), managed the plantation through years of war and reconstruction. With the ending of the slave era and the division of the properties the records other than correspondence are much abbreviated, being confined largely to accounts with servants and two inventories of the Massie estate. Her letters relate primarily to family matters and show little of the interest in national, state, and local affairs to be found in the correspondence of her husband and his father. With her death the plantation records come to an end.

William Massie's strong and persistent addiction to the accumulation and analysis of detail make his papers one of the most remarkable of known plantation collections. Besides retaining letters received, he kept a copy or a memorandum of many of those he sent. His roster of slaves, begun in 1815, was posted by himself and descendants as long as slavery lasted and virtually to the death of the Negroes concerned. It included births, deaths, acquisitions and dispositions, and comments on the morals, health and family relations among the slaves. The aggregate number of slaves listed was 345; a number of those surviving beyond 1865 appear also in Maria C. Massie's accounts

with servants. Continuous records from 1817 to 1861 show annual acreage planted and yield of crops, all costs of slave and hired labor, flour production, and the butchering and curing of pork. For all of the years between 1843 to 1860 Massie calculated not only his annual net income but also his profit per slave which ranged from 51 cents in 1844 to $98.39 in 1856.

Microfilm $16.90; Xerox $60.60. 1344 pages.

HISTORY OF THE MICHIGAN SOLDIERS' AID SOCIETY, 1861-1865.

(L. C. Card No. Mic 59-4993)

Robert Spiro, Ph.D.
University of Michigan, 1959

The purpose of this study is to present an account of the origin, development, purposes, and day-to-day operations of the Michigan state branch of the United States Sanitary Commission, a Civil War civilian organization devoted to furthering the health, comfort, and social welfare of Union soldiers.

The study is divided into chapters on a topical-chronological basis, starting with the founding of the Michigan Soldiers' Aid Society in November, 1861, and terminating with its official demise at the close of 1865. Within each chapter, primary emphasis is placed on the society's activities in obtaining food and clothing for soldiers by voluntary public contribution, since these labors comprised the largest part of its total work. Secondary aspects of the society's operations, such as the maintenance of a soldiers' home, and an employment agency for discharged veterans, are treated in the chapter or chapters corresponding chronologically to the time of occurrence of the actual events.

One result of the study indicates that the degree to which the Michigan public supported the society's program for all Union soldiers varied according to two factors: (1) enthusiasm for further war effort resulting from major Union victories; (2) the strength of the society's own promotional schemes effected through publicity and planned entertainments. The other result issuing from the study was the evident fact that the society acted as an administrative-advisory-instructional center for many Michigan societies and people engaged in some form of relief work for soldiers.

The conclusion, based upon the foregoing results, is that the Michigan Soldiers' Aid Society made a significant contribution to Union victory by giving form and direction to state-wide soldiers' aid activities.

Microfilm $5.85; Xerox $20.40. 457 pages.

THE ACQUISITION, DISPERSAL, AND INFLUENCES OF THE JAMES WATSON FORTUNE, 1783-1806.

(L. C. Card No. Mic 59-4668)

Glenn Edward Thompson, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Roy F. Nichols

Between 1783, when he moved to New York City from Connecticut, and 1806, when he died at the age of fifty-six, James Watson amassed a fortune as a commission merchant. He invested most of his money in land and securities. He was a philanthropist, an officer in the Cincinnati and the New England Society of New York, and successively a member of the Assembly and Senate of the State of New York, and of the United States Senate. He executed commissions in the public service of New York and for the national government. For the latter, he purchased the property that became the New York Naval Yard.

Watson's mercantile business reached along the Atlantic coast, into the Caribbean and the Mediterranean, and to ports in England and northern Europe. He purchased and sold on his own account and as a factor for others. He was a moneylender, and befriended Joel Barlow and Noah Webster in that capacity.

The Watson estate passed to his son, James Talcott Watson, who was mentally incompetent from time to time and committed suicide in 1839. Within a few years, the Watson fortune disappeared. The son dissipated some of it; the rest passed to over a hundred heirs after his suicide. A portion became part of the estate of young Watson's executor. Some of the land became part of the Adirondack Forest Preserve in New York State. Income from the executor's estate in 1919 became part of the endowment of an art school and gallery, Munson-Williams-Proctor Institute in Utica, New York.

The acquisition of Watson's fortune, his disbursement of it, his activities as a public figure of wealth and high social standing in New York City, and the scattering of his fortune after his death are the basic parts of this study. Some attention is paid to his legislative career and to his role as a supporter of Federalist state and national policies, 1791-1800.

Extant Watson business papers, including letterbooks, were the bases of the research. The manuscript records of contemporary merchant clients like Jeremiah Wadsworth of Hartford, Connecticut, were drawn upon heavily. Also used were journals and proceedings of the various public agencies that Watson served. Documentary sources covering the years of the son's control of the fortune were sparse. His executor's papers had to be relied upon, with supplementary material from public tax records and documents from the archives of Munson-Williams-Proctor Institute.

Examination of these records led to the conclusions that Watson was an able merchant, a man of notable public spirit, and a constructive citizen of his adopted region. Although he was not of the first rank in wealth or political leadership, he contributed to the growth of New York City and to institutions like the New York Hospital and the New England Society. His fortune was used to support insurance companies, banks, and individuals like Noah Webster. He was interested in canals and manufacturing enterprises, but neither brought great profit to him. His investment pattern was not unusual for his time.

Watson's money might have continued to support contributors to the American economy or to American culture, but Watson died at an early age and his heir was unable to manage his inheritance. The fortune that brought public prominence to its accumulator and helped his friends and clients was dispersed in a short time. Little influence of the money can be traced after James Watson's death. Without its founder, this fortune could neither grow nor contribute to the community within which it had been amassed.

Microfilm $3.70; Xerox $12.40. 285 pages.

JEAN JULES JUSSERAND AND THE FIRST MOROCCAN CRISIS, 1903-1906.

(L. C. Card No. Mic 59-4676)

Evelyn Virginia Wiley, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Lynn M. Case

The Morroccan question prior to 1914 is considered to be an important phase of pre-war diplomacy and has been approached generally from the European point of view. But, when President Theodore Roosevelt's role in the first Moroccan crisis of 1905-1906 was later revealed and verified, the diplomatic developments in Washington took on new significance. Jean Jules Jusserand, an experienced diplomat who had come to the United States as the new ambassador from France in 1903, faced in this crisis the first real test of his diplomatic skill. Through his friendship with the president and his influence in Washington circles he succeeded in enlisting support for France that was perhaps decisive in the diplomatic struggle with Germany over Morocco. This study attempts to assess Jusserand's contribution to the ultimate French victory in the crisis.

The basic sources are the despatches exchanged between Jusserand and the French foreign ministry published in the Documents diplomatiques français, 1871-1914, second series, the published and unpublished letters of the French ambassador and of the American officials with whom he was closely associated, records in the state department archives, and Jusserand's memoirs. The volumes in Die Grosse Politik covering the Moroccan crisis were used to follow the activities of Speck von Sternburg, Jusserand's German colleague. British and American published documents on the period before 1914, selected historical studies, and newspapers furnished information on the diplomatic scene as a whole.

Jusserand's intimate friendship with President Roosevelt was unique in the annals of Washington diplomatic practice. The two developed a mutual respect and admiration, shared many common interests, and spent much of their leisure time together. Significantly, in diplomatic dealings Roosevelt was to treat Jusserand with the same honesty and understanding that characterized their personal relationships.

While the crisis precipitated by the Russo-Japanese War was still at its height, the kaiser's visit to Tangier in March, 1905, and Germany's subsequent demand for a conference on Morroccan affairs brought the North African question to a head. Jusserand influenced Roosevelt to support French opposition to a conference, but when a meeting became inevitable the ambassador was assured that France could continue to count on American support. In defending French insistence on a preliminary program that would guarantee France's Moroccan accords, Jusserand convinced Roosevelt that a principle was at stake and that France was justified in upholding her international commitments.

When the conference met at Algeciras in January, 1906, Jusserand quietly cultivated American support for a Franco-Spanish mandate for the Moroccan police. Roosevelt intervened with a plan designed to secure the French position. Although a serious misunderstanding later arose over technicalities in the police organization, there is strong evidence that continued American resistance to German demands can be attributed to Jusserand's influence in Washington.

From this analysis the conclusions are that Jusserand's effectiveness as a diplomat can be ascribed to his personal and professional attributes and to his deliberate effort to develop diplomatic techniques geared to the realities of the American scene. Further, it was largely at his urging that Roosevelt became involved in the Moroccan crisis as deeply as he did. In enlisting the president's sympathy Jusserand gained impressive support for France and furnished real substance to Franco-American friendship.

Microfilm $3.85; Xerox $13.00. 298 pages.

THE POLICY OF LORD SALISBURY TOWARD FRANCE, 1886-1892.

(L. C. Card No. Mic 59-4677)

Richmond Dean Williams, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Lynn M. Case

The purpose of this dissertation is to describe the characteristics of Lord Salisbury's policy toward France in a period when England was associated with the central powers and France was moving out of isolation into an alliance with Russia. This study also seeks to discover whether, in light of Salisbury's Franch policy, evaluations of British policy toward the Triple Alliance, France and Russia must be modified. A corrollary to this study is to determine the influence of Anglo-French colonial rivalry on the relations between the two countries and consequently on European relations as a whole.

After a brief synopsis on his life and a general summary of the situation in 1886, Lord Salisbury's policy toward France is traced in regard to (1) the Eastern question, Egypt, the Suez Canal and the Mediterranean agreements; (2) French internal affairs; (3) French relations with other continental powers; and (4) French colonial aspirations as they came in contact with Great Britain in Newfoundland, the Pacific Ocean and Africa. The British diplomatic correspondence in the Public Record Office, London, and Salisbury's private correspondence in the Christ Church library, Oxford, provided the two main sources to ascertain Lord Salisbury's policy toward France.

It has been determined that Lord Salisbury considered that British interests in Europe and Egypt could best be

supported by cordial relations with Germany, Austria and Italy. At the same time Lord Salisbury wished to maintain as good relations with France as possible because (1) he did not want to encourage a war by either Germany or Italy against France; (2) he attempted to bring a restraining influence to bear on France; and (3) he had to negotiate a multitide of colonial disputes with France. The influence of overseas conflicts tended for the most part to hamper cordial relations because the good will created by occasional concessions to France was eroded away by the multiplicity of continuing grievances. This colonial rivalry--with the exception of Egypt--was mainly bilateral and thus did little to modify English policy in Europe. No evidence has been found in his policy toward France that Lord Salisbury tried to forestall the formation of the Franco-Russian alliance.

Lord Salisbury's policy toward France was mainly devoted to keeping on as good terms as possible and to solving or defining the differences between the two nations through conciliatory negotiation. He stood firm where the basic interests of England were concerned--in Egypt and Suez--but remained aloof enough from the popular enthusiasms of the day to be able to make realistic bargains which were unpopular at home and in the colonies. Although Lord Salisbury associated England with the Triple Alliance powers to insure the peace of Europe against the dangers of French instability (especially from 1887 to 1889) and to gain support for English policies in the Mediterranean, Near East, and Egypt, he retained his freedom of action from binding engagements directed against France. The need to counter the threat of France to Europe and yet to negotiate bilaterally about world-wide conflicts made Lord Salisbury's policy toward France independent and opportunistic. Microfilm $3.60; Xerox $12.20. 278 pages.

TILAK AND GOKHALE: A COMPARATIVE ANALYSIS OF THEIR SOCIAL AND POLITICAL PHILOSOPHIES.

(L. C. Card No. Mic 59-4679)

Stanley Albert Wolpert, Ph.D.
University of Pennsylvania, 1959

Supervisor: Professor Holden Furber

What were the social and political philosophies of Bal Gangadhar Tilak and Gopal Krishna Gokhale? What were the stimuli to which each responded? Were they intellectual innovators, or did they follow in established streams of thought? How great an influence did each exert upon the other, and on the course of affairs in his lifetime? How significant a contribution has each made to Indian history, and the development of free India's thought and institutions? These are the principal questions which this dissertation seeks to answer. It is based primarily upon private papers and newspaper files, both English and Marathi, preserved in Poona, where both Tilak and Gokhale spent the greater part of their mature lives. The pertinent materials in the National Archives in New Delhi, and in the Bombay State Archives, as well as in the London India Office Library and the British Museum were also utilized.

Because of the powerful influence which the ideas of each of these foremost leaders of India's Nationalist Movement in the pre-Gandhian era exerted upon the other, I have attempted to trace their evolution in juxtaposition, viewed against the backdrop of their lives and times. Though sharing much the same Brahmanical Maharashtrian environment, Tilak and Gokhale responded in singularly different manner to the stimulus of Western learning and the consolidation of British rule in the latter part of the nineteenth century. Tilak early joined Vishnu Hari Chiplunkar (1850-1882) in his militantly nationalistic rejection of the foreigner and most of his products, mental and material, in favor of a revived devotion to Hinduism. Gokhale, on the other hand, followed in the tradition of his guru, Mahadev Govind Ranade (1842-1901), and was to personify the evolutionary mainstream of India's nationalist movement, stressing the harmonious rather than the antipathetical in the cultures of India and England.

Introduced to Western learning at almost as early an age as Gokhale, its poetry and philosophy struck no responsive chord in Tilak's mental makeup. With an orthodox appreciation of the rich and profound heritage of his own people's culture, moreover, Tilak viewed British rule as a predatory foreign incubus. He was concerned more with liberty than social equality, and his tactics were to agitate and organize amongst the urban masses. Though providing scriptural justification for revolution he adhered to no particular revolutionary theory, outlined no long range program of action. His goal was Swaraj ("self-rule"), and he was neither squeamish nor doctrinaire as to the methods employed in attaining it. He approved of violence on the one hand, and "responsive cooperation" on the other. He stimulated Hindu religious revivalism, stirred Maharashtrian regional pride, and attacked scientific innovations and utilitarian social reforms as the handmaids of foreign ideology and religion.

To Gokhale's mind the English connection with India was providentially ordained, sent to stir his stagnating civilization from its long lethargy. A careful student of Milton, Burke, and Mill, Gokhale early developed an unshakeable faith in the integrity and beneficience of the English nation. He was an optimist and idealist, taking for his watchwords, liberalism and moderation. He believed in the progressive perfectability of all mankind, especially through the agency of free and compulsory education. He stressed the need for social reform to affect India's transition from a caste-ridden and communally divided society to one of equality of opportunity and social harmony, fully capable of governing itself. Abhorring all violence, Gokhale was less concerned with the rapid realization of the goal of freedom than with the purity of the means employed. He was in many ways more of an Internationalist than a Nationalist, more of a humanitarian than a patriot.

Microfilm $6.40; Xerox $22.20. 504 pages.

SOME PROBLEMS FACED BY INDIANS AND AMERICANS IN EARLY YEARS OF MARRIAGE.

(L. C. Card No. Mic 59-5112)

Saroj Khanna, Ph.D.
The Pennsylvania State University, 1959

The prupose of the study was to investigate the nature and frequency of home and family problems encountered during the first five years of married life by Indian and American married men and women.

An instrument on home and family problems was prepared and a modified questionnaire method was used for obtaining the data. The total sample consisted of 320 men and women, including 87 Indian men and 73 Indian women and an equal number of American men and women. Two criteria were applied in selecting the Indian sample, namely, the person (1) should have lived in India for at least two years after marriage and (2) should have been in the United States no more than three years. The American sample matched the Indian sample with respect to years of marriage, age of partners, education and financial status. In addition, the sample included only those who were at least second generation Americans. The participants were located in Washington, D.C.; New York City; Philadelphia; Pittsburgh; Baltimore; Ithaca, New York; and State College, Pennsylvania. In order to test the significance of the differences among the responses of the Indian and American men and women, a chi-square method of analysis was used.

In the first hypothesis it was assumed that Indian and American men and women would differ in their evaluation of representative home and family problems. It was found that:

a. Approximately one-third of the total problems, 36 out of 104, were found to be significantly different for the two groups. Problems that received a higher response from the Indian sample were: management of servants, lack of adequate sanitary living conditions, too much difference in the educational level of partners, and the need of money for better health care. Problems that were found to be significantly higher for the American sample included: partner not able to communicate freely, undisciplined children, inadequate demonstration of affection by partner, and lack of time for social functions.

b. The nature and frequency of home and family problems was more severe for the:

   1. Indian sample for the areas of living conditions and financial management.
   2. American sample for the areas of personal problems and family relations, moral and religious, and social and recreational.

In the second hypothesis it was assumed that men and women independent of national origin may be expected to differ in their evaluation of representative home and family problems. The findings support the hypothesis by bringing to light that:

a. Of the total of 104 problems, 12 differed at the .01 to .05 level for men and women. Examples of the problems that received a higher response from the women were: uneven distribution of daily jobs at home, losing temper easily, too many guests, and extravagance by the partner. Problems that confronted men more than women, included lack of time to take part in social life, and working over time.

b. The nature and frequency of problems checked by women were less severe than those indicated by men in the areas of social and recreational, and working conditions.

In the third hypothesis it was assumed that the nature and frequency of occurrence of selected home and family problems differs with the level of education of the participants. For the Indian sample the nature and frequency of home and family problems was more severe for the participants with a high school education or less than for those with higher education. The relationship was less marked for the Americans.

In the fourth hypothesis it was assumed that the nature and frequency of occurrence of selected home and family problems differs with the financial status of the participants. The analysis reveals that a greater number of problems is faced by the lower income group of both the Indian and American participants.

All the four hypothesis were supported.

Microfilm $2.55; Xerox $9.00. 196 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

THE STATE PROMOTION AGENCY: AN ANAYLSIS AND COMMENTARY.

(L. C. Card No. Mic 59-4544)

Richard Eugene O'Brien, Ph.D.
University of Illinois, 1959

The purpose of the thesis is to study the state promotion agency as a communication organization, to note its position in contemporary society, to describe its deficiencies and difficulties as an effective communication organization, and to offer certain recommendations based on the findings of recent studies. The conceptual framework is that of a communications net: the source, the audience, the media, and the message. Many of the findings are based upon the activities and history of the Missouri Division of Resources and Development.

The methodologies in the investigation are determined by the particular area and aspect of the study under consideration. These methodologies and their conceptual orientations are selected from the fields of economics, marketing, communications research, and philosophy. The usefulness of the study is to promote a better understanding of the state promotion agency by filling a gap in the literature on this type of communication organization.

The source of communication, or the organization itself, is analysed in terms of its relationships to the governmental planning movements in this country which are briefly traced back to the Pre-Revolutionary Period. It is found the state promotion agency is intimately related to these planning movements and that the movement for tourist and industrial promotion by a state agency received great impetus through technological and social developments of the Twentieth Century. It is also found that natural law ethics and the economic principle of comparative advantages provide an adequate framework for the justification, activities and goals of the state promotion agency.

In the discussion of the audience, the socio-economic forces of population growth, mobility, paid vacations, personal income, per capita debt, age and position in the life cycle are analysed for their effects on the size and growth of the pleasure travel market. A double-nested relationship between automobile mileage and total lodging receipts is offered as a method of estimating total pleasure travel expenditures on the national level and within each state.

A history of Missouri's various advertising programs is offered in conjunction with the use of many different media. A critique of the various media based upon the findings of communication research is presented with emphasis on the aspects of retention and persuasion. Certain recommendations are offered as a means of increasing the effectiveness of a promotion campaign through media experimentation.

The messages used by the Missouri Division of Resources and Development are analysed in the light of accepted advertising mechanics of message formation and presentation and also for their effectiveness in generating coupon returns. Certain deficiencies are cited and it is found this Division and their advertising representative often ignore some of the basic rules and principles of effective communications.

Microfilm $3.75; Xerox $12.80. 291 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

LANGUAGE AND LITERATURE, GENERAL

A STUDY OF THE IMAGERY IN SHAKESPEARE'S AS YOU LIKE IT.

(L. C. Card No. Mic 59-4441)

Mary Carol Culver, Ph.D.
University of Pittsburgh, 1959

Adviser: Charles R. Crow

There are two justifications for a study of As You Like It: Shakespearean comedy in general has received inadequate attention, and As You Like It in particular has been too often mistakenly regarded as one of Shakespeare's most casual pieces of work. A study of the imagery of a comedy is also needed because although the imagery of Shakespeare's plays has been the subject of many studies since 1930, the imagery of the comedies has been largely ignored. The chief reason for this seems to be that the imagery of the comedies does not form a thematic pattern such as has been found to exist in many of the tragedies. An examination of the imagery of As You Like It shows, however, that the imagery is of primary importance in the play and that it has been carefully chosen.

In this study the term imagery has been limited to figurative comparisons—i.e., metaphor, simile, and personification.

The imagery in As You Like It has two important functions: it creates atmosphere and controls the tone. The atmosphere is an outgrowth of the physical setting, which is a mingling of details from rural England, Robin Hood tales, classical literature, and romance. Although there is little actual description of setting, imagery related to these various elements of setting occurs in the conversation of the characters no matter what topic they are discussing. The resulting atmosphere is a combination of the real and the ideal. We recognize details of the place so that it seems real and familiar, yet we know at the same time that life in a forest was never like this. But we wish that it were. The Forest of Arden is a golden place that pervades the imagination of the characters and allows them freedom of action and speech. It is a familiar yet picturesque setting for all the familiar and picturesque poses that the characters adopt.

The tone of As You Like It is more important than the atmosphere. The tone is both satiric and nonsatiric. On one level the play satirizes pastoral literature and romantic conventions, and on another level it accepts both of these. The tone must therefore seem to ridicule and admire simultaneously. In achieving this balance of tone the imagery is of great importance.

In examining the tone of the play it is necessary to concentrate on the imagery of the chief satirists—Touchstone, Jaques, Celia, and Rosalind. Because Rosalind dominates the play, her imagery demands the most attention. The comedy developes primarily from the commonsense attack that these characters make on the impossible ideals presented in the play. But the tone of their attack is controlled in such a way that it is clear that the ideals are not meant to be utterly destroyed. This control is achieved largely through the careful selection of imagery. The imagery manages to make us laugh at and admire the object of the satire both at the same time.

To regard As You Like It as the product of careful rather than casual work accords with the general tendency of twentieth-century criticism to view Shakespeare not as an untrained, careless, or erratic genius but as a conscious artist, a playwright with sound dramatic judgment who exercised careful control over all aspects of each play.

Microfilm $2.00; Xerox $5.60. 111 pages.

CHARACTER AND ACTION IN KING LEAR, A RECONSIDERATION OF SOME RECENT CRITICISM.

(L. C. Card No. Mic 59-4309)

John C. Ellis, Ph.D.
University of Oregon, 1959

Adviser: Ernest G. Moll

This study examines the relationship between character and action in King Lear, focusing especially on the protagonist, and reconsiders the Lear criticism of three important and influential twentieth-century Shakespeare Scholars -- Elmer E. Stoll, Levin L. Schücking, and G. Wilson Knight. Against these critics, the study argues for the credibility of Lear's action and for his consistency as a tragic figure.

Professor Stoll holds that King Lear is psychologically inconsistent and that his action is frequently incredible. Shakespeare was seldom concerned with consistency and credibility, Stoll believes, but with startling and effective complications and reversals, which he achieved at the expense of the characters. Professor Schücking, like Stoll, a "historical" critic, is of a similar opinion concerning Shakespeare generally, but he thinks that in creating Lear Shakespeare achieved what was for him a remarkable consistency. Schücking contends that Lear is presented as nearly mad at the beginning of the play, and that his career thereafter is one of steady, anti-climactic degeneration as he follows the path of the conventional Elizabethan Melancholy Man to his predictable ruin. Thus, for Schücking, Lear is consistent, however much the effect of the tragedy may be weakened by the consistency.

Professor Knight's commentary emphasizes both the incredibility and fantasticality which he finds, with Stoll and Schücking, in the play, and the weakness of mind which he asserts to be characteristic of Lear. But he argues that these are faults only when viewed "critically." Knight tries to avoid what he terms criticism, and focuses imaginatively on images and symbolic elements, from which he interprets for the play a Purgatorial vision. (For Knight, King Lear is one of an eschatological trinity, with Macbeth representing Hell and Antony and Cleopatra, Paradise). This study tries to show that although Knight rejects the criticism of character he does depend, like Stoll and

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Schücking, upon a distorted view of character to arrive at his interpretation.

Examining the play and these three critical views, this study argues that King Lear is endowed with a nobility of character properly tragic, and that Shakespeare presents him as consistent and credible throughout the action. The study follows Lear from the opening situation, points out his motives for the attempted division of the kingdom, and accounts for his behavior in the complication of the tragedy. It traces and defends his consistency, development, and dignity as he struggles both for and against a recognition of his plight and moves toward his reversal in Act II. The study also points out the underlying theme of Lear's subsequent delirium: the repression of guilt, which is related to his earlier behavior.

Lear's early action in Act IV prepares him, it is noted, for his reconciliation with Cordelia, where he deals with his guilt openly, and recovers. At the catastrophe of the play he is struck down by his recognition of Cordelia's death, which at first he tries to evade, but which the conditioning of his character by his vicissitudes throughout the play forces him to accept. Having emphasized Lear's psychological continuity from the beginning, the study concludes that the character of Lear and the structure of the play are not mutually exclusive, but interdependent.

Four appendixes are supplied with the thesis. Sketches of the Shakespeare criticism of Stoll, Schücking, and Knight are presented in the first three. The fourth deals with the subplot and defends some episodes in it which have come under critical attack.

Microfilm $3.45; Xerox $11.60. 265 pages.

HEROIC NARRATIVE TECHNIQUE IN THE ANGLO-SAXON CHRISTIAN EPIC.

(L. C. Card No. Mic 59-4312)

Leonard Hamilton Frey, Ph.D.
University of Oregon, 1959

Adviser: Arthur G. Brodem

This thesis is a study of the techniques whereby the Latin and the Anglo-Saxon Christian epics created heroic narrative in the interests of early medieval Christianity. Beginning with a survey of the theories relevant to the establishment of epic poetry in England, the thesis proceeds, from the Anglo-Saxonist's point of view, to analyze the narrative technique of the Latin Christian epic, as necessary background for the understanding of Anglo-Saxon technique.

The Latin Christian epic was known to the Anglo-Saxon monastic Christians, according to historical evidence. As an artistic genre, it may be shown to derive from classical Latin (Vergilian) epic practice, gradually taking on rhetorical aspects other than epical in the course of about three centuries (4th to 6th). The history of the Latin Christian epic is one of a progression from serious imitation of Vergil to indiscriminate playing with rhetorical types: anacrostics, etc.

The Anglo-Saxon Christian epic, the center of inquiry in this thesis, is looked at both widely and narrowly, in terms of examples drawn from a number of poems and in terms of a single poem, the Elene. Anglo-Saxon Christian epic technique, viewed in terms of examples drawn from the genre as a whole, resolves itself into variational technique - the accumulation of epithets, appositives, etc., that gives emphasis to Christian heroism - and situational technique - the development of heroic Christian values in terms of traditional Germanic values which would have been familiar to the Anglo-Saxons. It is in this situational technique that the independent Anglo-Saxon contribution to Christian epic poetry in general rests. Situational technique is analyzed through three basic categories of heroic experience: warfare (advances to battle, battle itself, and battle comradeship), seafaring (successful sea-journeying and storms at sea), and the hardship of the exile. These categories dramatically suggest how the Anglo-Saxons were able to imagine and understand the heroic moments in the Scriptural and hagiographical material they turned into epic poetry.

The analysis of a single Anglo-Saxon Christian epic, the Elene, suggests how the Anglo-Saxons combined situational with variational technique in the course of a whole narrative action. The thirteen hundred odd lines of the poem are typical of the Anglo-Saxon Christian epic in general, in regard to this.

The concluding summary clarifies what the thesis as a whole has argued: the Anglo-Saxons had in the Latin Christian epic an obvious model for the formulation of their own Christian epic practice, but actually the Anglo-Saxon Christian epic is a development beyond the Latin and a striking Germanic contribution to medieval poetics.

Microfilm $2.20; Xerox $7.80. 166 pages.

HISTORY OF THE NIXON THEATER, PITTSBURGH, PENNSYLVANIA.

(L. C. Card No. Mic 59-4449)

Dorothea Breitwieser Gardner, Ph.D.
University of Pittsburgh, 1959

The problem of this thesis is the problem of any history: to record what happened during a certain period of time and to show how people effected these events and how the events affected people. Accordingly, the opening of the Nixon Theater, its managers, stars who played there, musicals and plays that were performed on its stage, reactions of audiences and of drama critics to these productions, and the closing of the theater have been discussed in this thesis.

Because the Pittsburgh newspapers provided the only continuous records of events at the Nixon Theater, they have been used almost exclusively as sources. Variance between views of drama critics and audiences, indicated either by the critics themselves in their reviews or by box-office success or failure of a production, has been noted.

Chapter I discusses the building of the theater, the excellencies of its equipment, the first night audience and program, and the pride with which Pittsburghers regarded the Nixon Theater as a symbol of the city's affluence and its cultural development.

Chapter II treats the men who managed the Nixon,

primarily Harry Brown, who led the theater through its most successful years, 1916-1941.

Chapter III reviews the musical entertainment offered by the Nixon. It shows the trend away from Grand Opera and other "refined entertainment" of the early years of the twentieth century, to lighter musical comedies and revues of the twenties, and finally to more serious but less frequent musical entertainment in the thirties and forties. The conflict between "star companies" and those that refused to operate the star system is also reported. Musical productions of noted Broadway producers are analyzed and compared. Performances of all the musical stars who played at the Nixon are reviewed; those of stars who appeared most often, in great detail; lesser stars, briefly.

Chapter IV presents plays enacted and dramatic stars who performed at the Nixon. It shows a trend away from Shakespearean and other "classical" drama that appeared frequently during the early years, to lighter and fewer plays in the twenties, and finally to the dramatic revival of the thirties and forties. Performances of actors and actresses are discussed in the order of the number of star appearances they made at the Nixon.

Chapter V summarizes the trends already indicated and suggests that theatrical trends in Pittsburgh were indicative of theatrical trends throughout the country. The decreasing interest in theatergoing is noted by reference to the closing of other Pittsburgh theaters and to the shortened seasons at the Nixon, the only legitimate professional stage existing in Pittsburgh after 1934. Other programs not discussed in preceding chapters are briefly mentioned, as well as the gradually decreasing number of pleas by the drama critics for morality on the stage.

Chapter VI views the closing of the Nixon as seen by the New York Times, notable living actors, the Pittsburgh public, and the Pittsburgh drama critics.

Four Appendixes are included to give a statistical account of Nixon programs, stars, and playwrights. Appendix A lists in chronological order the programs presented on the Nixon stage, and it notes tryout performances and Theatre Guild productions. Appendix B lists these programs alphabetically and gives, in addition, the names of their authors and producers and the dates when they were presented at the Nixon. Appendix C lists in alphabetical order the names of stars; Appendix D, the names of playwrights.

Because the Nixon Theater was the only theater in Pittsburgh to offer as many as 47 uninterrupted seasons of what was considered the "highest type" of musical and dramatic entertainment, because many notable actors played there, and because many notable productions were staged there, the Nixon Theater was an important part of Pittsburgh's theatrical life during the first half of the twentieth century.

Microfilm $7.25; Xerox $25.00. 571 pages.

THE FUGITIVE POEMS OF RICHARD HENRY WILDE WITH AN INTRODUCTION.

(L. C. Card No. Mic 59-4622)

Ralph S. Graber, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Thomas P. Haviland

Poet, Italian scholar, and congressman, Richard Henry Wilde is an interesting ante-bellum figure in the Southern literary, political, and social scene. I have gathered here all of his original poetry known to exist, with the exception of the lengthy Hesperia, and have included examples of his translations. I have indicated the variant readings of the poems Wilde left in rough draft, have noted differing readings in the published versions or several manuscripts of a poem, and have corrected errors in previous texts that resulted from faulty reading of the manuscripts. The publication history of the poems is given.

The six introductory chapters evaluate Wilde's work and show his relationship to his times. The first treats his poetry and poetic theory and shows how Wilde was torn between the desire to devote his time to literature and the necessity of making a living by practicing law. It is likely that his constant complaining that he was too busy with other things to devote his time to literature was a rationalization of his inadequacies as a poet. He also criticized the mechanization of our country and its growing materialism, and contended that neither he nor America could produce poetry of high order. His reputation today as an original poet rests on Hesperia, a few sonnets, and "My Life Is like the Summer Rose."

The next chapter shows how previously unpublished poems in the Library of Congress confirm the identification of Mrs. Ellen Adair White-Beatty as the Marchioness Manfredina di Cosenza, the "one adored in vain," to whom Wilde dedicated Hesperia. The connection of Wilde and Mrs. White helps to explain the increasing melancholy and fatalism in Wilde's poetry.

Then follows an account of the notorious plagiarism controversy that arose over Wilde's "Summer Rose." A hoax to test the scholarship of a few people led to a widespread controversy that embarrassed Wilde and increased his disgust with America.

The fourth chapter discusses Wilde's career in Congress and his political philosophy. During a time when loyalty to a party was essential for political success, Wilde considered each issue as an independent thinker. A man of principle, he often acted in a manner that was politically fatal. An idealistic patrician, he was hopelessly out of place in a Congress under the earthy Andrew Jackson, whom he detested and who he felt might become a dictator. Wilde's speeches on the revised tariff bill (1833) and the removal of the deposits from the Bank of the United States (1834) were the most important delivered in the House on those questions. I have included an evaluation of Wilde's speeches, his delivery, and his reputation in the House.

Next is an account of Wilde in Italy and his Italian studies. The reviews of his Tasso are examined and the work evaluated. Wilde's unpublished Life of Dante is described, as well as his role in the recovery of the lost Giotto fresco of Dante. It was unfortunate for the progress of Dante studies in America that Wilde did not complete and publish his work.

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The last chapter tells of Wilde's return to America and his later removal to and residence in New Orleans, which he found even less stimulating culturally than Augusta.

There are two appendices. The first points out poems incorrectly assigned to Wilde. The second is the unpublished biographical sketch of Wilde by his son, John P. Wilde.

Wilde's appeal is due not to his accomplishments in any one area, but to his work as a whole. In it we see the efforts of a sensitive, thoughtful, widely read man to evaluate his age. Microfilm $5.25; Xerox $18.60. 411 pages.

THE DECLINE OF ROME IN NINETEENTH-CENTURY ENGLISH FICTION.

(L. C. Card No. Mic 59-4070)

Doris Borrup Kelly, Ph.D.
Columbia University, 1959

During the nineteenth century historical fiction with a background of Roman history became increasingly popular. The period of Roman history popularly called "the decline of Rome" began with imperial times and early Christianity and therefore afforded writers opportunities for drawing contrasts between paganism and Christianity and parallels between ancient Rome and modern England. Popular interest in Roman history, as a study of such periodicals as the Quarterly, the Westminster, the Edinburgh, Blackwood's and Frasers's shows, was evident in the number of reviews of historical works, articles on archaeology and Roman literature, and discussions of early Christian development.

The historical novels about Rome may be divided into three categories. The didactic and religious group included a flood of fiction for juveniles' Sunday reading as well as a number of novels designed to impress a Broad Church, High Church, or Catholic point of view upon the reading public, the most interesting being Hypatia, Callista, and Fabiola. The historical romances and adventure novels were concerned directly with telling a tale against the exciting and dramatic background of Rome's decline and were only indirectly concerned with Christianity. This group included Lockhart's Valerius, Bulwer's Last Days of Pompeii, Collins' Antonina, Whyte-Melville's The Gladiators, and Gissing's Veranilda. The third category of Roman novels may be called philosophical romances, of which the most successful and most important was Marius the Epicurean.

The writers of historical novels about ancient Rome were faced with more difficult problems of construction than writers who chose periods of history closer to modern times. The devices of the lost manuscript, of the epistolary form, of other first-person narration, and of the stranger hero were tried by various writers to help bridge the immense time gap. The Victorian convention of direct address to the reader was used in greater or lesser degree, and parallels between Rome and England were introduced to make the nineteenth-century reader feel at home in ancient Rome.

Parallels between Rome and England were a commonplace in nineteenth-century thinking to such an extent that a reader did not need to have the parallels explicitly drawn for him, although in some novels the writers express the intended parallels directly. The degradation of the Romans in the period of decline and the implied superiority of subject races such as the Greeks, the Jews, and especially the Goths and Britons serves both as a warning to nineteenth-century Englishmen to avoid the excesses of the Romans and as an expression of patriotic fervor and sympathy for the subject races with whom the Englishman's ancestors are identified. Parallels and contrasts between ancient and modern Christianity are plentiful in these novels and warnings of the catastrophe which might befall a wicked city like London are seen in the numerous depictions of the fall of an ancient city.

A comparison of nineteenth-century novels about Rome with those written during the last few decades shows that the fictional biography or autobiography has become the most popular form for the modern Roman novel. It also shows that the period of the republic, or of the dissolution of the republic, is of greater interest to modern novelists than it was to nineteenth-century writers of historical fiction, probably because modern writers are more interested in political parallels with Rome while nineteenth-century novelists found their inspiration in the period of the development of Christianity.

Microfilm $3.10; Xerox $10.60. 237 pages.

ENGLISH VERSE OF COMPLAINT, 1250-1400.

(L. C. Card No. Mic 59-4940)

Thomas Leroy Kinney, Ph.D.
University of Michigan, 1959

This study attempts to answer three questions: (1) Does a body of verse exist of sufficient homogeneity to be termed a "kind" and should it be called "complaint"? (2) What are the characteristics of the verse? (3) Is it worthy of study and, if so, why? The verse included in this survey has long been used to furnish analogues to Chaucer and illustrations for historians. A description of the verse as a whole in its own context furnishes a broader and more comprehensive view of the verse for its use in such scholarship.

The procedure of the research was as follows: (1) verses termed "didactic," "satirical," or "complaint" by editors and anthologists were collected: (2) common characteristics were educed and a preliminary definition of "complaint" made, as a poem which laments the abuses of the age and/or criticizes those in authority; (3) other poems fitting this definition were collected; (4) the body of verse falling within this preliminary definition was analyzed in three ways: (a) what does the poem complain about? (b) how is the complaint made, that is, what is the temper of the verse, what devices and what verse forms are used? (c) who speaks to whom and attacks whom? Chapter II discusses the General Complaints which lament the abuses of the time. Chapters III, IV, and V consider complaints about the nobility, the clergy, and the third estate respectively. Chapters II through V form a subject index to the criticisms made in the verse. Chapter VI considers the temper, devices, and forms of the verse.

The results of the analysis showed that the verse complains about a wide variety of topics, but that the covetousness and "maistri" of the nobility and clergy receive most

criticism, and that, relatively, the third estate receives less. The moral criteria for the complaints derive from orthodox Christian doctrine, but covetousness, pride, and lack of charity predominate. The verse reveals a central theme, that the upper two estates did not fulfill their feudal obligations to the third estate. The complaints are made in tones of lamentation, despair, fear, frustration, and anger, and they are made indirectly to protect the poet from prosecution. The devices used to make the complaint indirect include personification, representation, allegory, pilgrimage or quest, trial or debate, dream-vision, and beast-fable. The forms of the verse range from the long alliterative line to a 12-line stanza, but there are more alliterative than rhymed lines.

The conclusions drawn are: (1) The body of verse is of sufficient homogeneity to be called a "kind" of literature in that the objects, temper, devices, authors, and audiences are sufficiently alike and within a narrow range of variety; (2) It should be called "complaint" inasmuch as the poet avoids didacticism and because the verse is not like earlier or later satire; (3) Much of the verse is of considerable merit and effectiveness and reveals skill and imagination in organization and phrasing; (4) The verse is popular in origin and appeal and indicates popular attitudes and concerns of the times, and the uneasiness, unrest, and fear caused by the evolution of economic, political, social, and religious institutions; (5) Studied as a whole, the verse furnishes insights into other literature of the period, including Rolle, Langland, Wyclif, Chaucer, and Gower.

Microfilm $4.50; Xerox $15.20. 352 pages.

ROBERT SOUTHWELL'S SHORT RULE OF GOOD LIFE: AN EDITION.

(L. C. Card No. Mic 59-5286)

Richard Morgan Loomis, Ph.D.
Cornell University, 1959

Robert Southwell's Short Rule of Good Life is a brief spiritual directory written originally for the guidance of Anne Howard, Countess of Arundel, at whose London residence Southwell lived secretly from about 1586 to 1590. An early application of Jesuit devotional techniques to the needs of a layman householder, it belongs to the genre of religious rule, offering practical and compact prescriptions for daily conduct. Although the Short Rule has literary as well as historical value, it has not been printed since the seventeenth-century. It is extant in eight early editions, produced between 1595 and 1636. The principal problems facing the editor of the Short Rule are the following: there are no extant manuscript copies of the Rule; it was apparently not printed until after Southwell's death; three of the extant editions present a version of the Rule substantially different from that in the other five editions; four editions are printed without date, place, or name of publisher. The variant version in three of the early editions appears to be a Protestant revision of Southwell's original work; the three editions in question are dated issues (1620, 1630, 1636) of English commercial presses. The undated editions appear, from typography and layout, to be products of secret recusant presses operating in England, circa 1600. One of the undated editions is distinguished by readings better than those in the other editions and by a complex collation of leaves, suggesting that it was set from a manuscript. That edition, of which the only known copy is at St. Cuthbert's College, Ushaw, is numbered 787 in A. F. Allison and D. M. Rogers, A Catalogue of Catholic Books in English Printed Abroad or Secretly in England 1558-1640 (Bognor Regis, 1956). It was probably printed between 1595 and 1597, perhaps under the supervision of Henry Garnet, who had been Southwell's companion and superior. Collation of texts indicates that the other undated editions, as well as a 1622 edition from St. Omers, were derived, directly or indirectly, from AR 787. Collation also indicates that the Protestant version, first printed by William Barrett in 1620, may have been based on AR 787. AR 787 has, therefore, been adopted as copy-text for the present edition. Its spelling and punctuation have been retained. The variant readings of the early editions are discussed in detail in the Textual Introduction, and emendations of the copy- text, both substantive and accidental, are tabulated. Material of doubtful authenticity appearing for the first time in the Barrett edition of 1620 is reproduced in an appendix.

Microfilm $2.85; Xerox $9.80. 218 pages.

JONATHAN SWIFT'S POLITE CONVERSATION, WITH AN INTRODUCTION AND NOTES.

(L. C. Card No. Mic 59-736)

Philip Rathbone Micks, Ph.D.
Columbia University, 1958

The text of Swift's Compleat Collection of Genteel and Ingenious Conversation, as printed by Faulkner in 1738, is presented in full with notes on many of the details in Swift's introductory "Treatise" and on most of the expressions contained in the three dialogues. Because this study was completed before the publication of Mr. Herbert Davis's edition, the present text is based upon a microfilm of Faulkner's book supplies by the Huntington Library.

An introduction of five sections attempts to summarize the background of the book and to re-evaluate Swift's purpose and achievement. Possible date or dates of composition and also various dramatic adaptations of Polite Conversation are discussed first. A second section calls attention to some of Swift's attitudes and values in relation to language and manners. Third, details and themes treated satirically in Swift's book are related to the historical background, the England of George II and Walpole. A fourth section suggests that Swift poured into the book linguistic material from two general sources. The bulk of the dialogues consists of proverbs, hackneyed word-play, and ancient jests, most of which material was traditional and available to Swift in written form. Interwoven with this traditional matter are examples of features of the language which Swift regarded as contemporary corruptions of English: clichés, catch-phrases, slangy colloquialisms, neologisms, "clipped" words, and "fashionable" pronunciations. A final section points out that Polite Conversation is more than an amusing example of Swift's propensity to play with language; it conveys, at least by implication, Swift's serious concern at what he saw as degeneration in the language and manners of the society

of his day. Like A Tale of a Tub, this book is also an attack on modernity. The emphasis, however, is not on religion and formal learning but rather on conversation and manners.

The body of this study consists of text and notes. In annotating the phrases of Polite Conversation, my purpose has not been to discover ultimate sources but rather to establish, whenever possible, the currency of the expressions in the seventeenth and early eighteenth centuries. For the proverbial material modern books like Tilley's have been used extensively as well as early collections of proverbs, which Swift might well have known, such as those of Ray, Kelly, and Fuller. Wide reading, especially of the more ephemeral writing of the period, yields many parallels to expressions employed in Polite Conversation. Fruitful sources for features of the language which Swift regarded as modern corruptions are the comedies and also the works of very colloquial writers like Brown, Ward, D'Urfey, and L'Estrange. The Oxford English Dictionary is frequently cited, especially for words which were relatively new in Swift's day or which were being given new applications. An important conclusion arising from the study of the varied linguistic elements of the book is that it should not be regarded solely as a satiric treatment of the actual speech and manners of Swift's age. The large amount of traditional material included indicates that Polite Conversation belongs primarily to the genre of burlesque.

Appendices include the following: Huntington Library Ms. 14341, a fragmentary list of phrases in Swift's hand, some of which resemble expressions contained in Polite Conversation; a collation of Faulkner's text with the slightly earlier London edition of 1738; a list of the major repetitions in Polite Conversation; the full text of the adaptation staged at the Drury Lane Theatre in 1740; extracts from Tittle-Tattle, another dramatic version which was published but evidently not performed; the text of the radio dramatization presented by the British Broadcasting Corporation in 1949; and, finally, a list of the phrases and expressions in Polite Conversation for which satisfactory annotation has not been achieved.

Microfilm $8.95; Xerox $32.00. 707 pages.

THE INTELLECTUAL BACKGROUND OF THE VISION OF PIERS PLOWMAN, WITH PARTICULAR REFERENCE TO THE ENGLISH AND LATIN WRITINGS OF JOHN WYCLIF. (VOLUMES I AND II).

(L. C. Card No. Mic 59-3899)

William Packard Palmer, Ph.D.
University of Kansas, 1957

The investigation explores some of the cross-currents of philosophical, religious, political, and social ideas of 1360 to 1385 in England, as those cross-currents are revealed in the writings of John Wyclif and William Langland. The many parallels in the ideas of the two serve to increase the possibility of a closer intellectual relationship between them than that of their merely sharing a common cultural background. There is no evidence, however, of a direct interchange of ideas on the part of the two.

The study stresses the pronounced Neoplantonic realist ontological orientation of Wyclif in contrast to the more apparently Aristotelo-Thomist, or moderate, realism that lies behind Piers Plowman. In their psychologies, however, the two writers are more nearly alike, holding to an essentially Aristotelo-Thomist interpretation of the roles of the agent and possible intellects and of the will. Both writers depart markedly from Aquinas in their belief in intuitional knowledge, in this holding to a characteristically Augustinian position that aligns them with tendencies in fourteenth-century mystical thought. Particularly in Wyclif, too, there is a tendency to exalt the role of faith as an important adjunct of knowledge. Both writers, in fact, display marked mystical sympathies (this has frequently been denied in the case of Wyclif) without necessarily being mystics.

In Langland the role of free will is inevitably less circumscribed than it is in Wyclif, and in this he exhibits Thomist leanings: the position is that of contingent rather than absolute necessity. Both writers vigorously combat the Neopelagianism popular in fourteenth century Franciscan thinking that sees human free choice as being virtually untrammeled.

Wyclif and Langland both display liberal views about certain of the sacraments, most notably that of penance. Here they stress the primary importance of contrition as constituting the salvational essence of the sacrament. Langland, however, holds to a rigidly orthodox belief in transubstantiation, whereas Wyclif heretically rejects transubstantiation, principally on the ontological ground that substance cannot be annihilated.

An attempt is made to discover if the strong antifraternal bias of the two writers is rooted in a common opposition to the disruptive and divisive activities of the friars in England that seem to have reached a peak at about the time of the Great Schism (1378), but it appears that their opposition reflects wholly different concerns on the part of each writer. Langland uses the friars as an artistic foil for his portrayal of the flawless Christian character of Piers. Wyclif's opposition is rooted in his fear that the Nominalistic or conceptualistic philosophical and theological opinions of the friars posed a death-threat to the intensely realist beliefs that he cherished.

In the monarchy both writers see a stable and workable order worthy of perpetuation. They both voice a sincere and bold opposition to war. In their common advocacy of evangelical poverty as the true Christian way and of the communal ownership of the earth's natural resources, they approach the "communism" of the primitive Christian church. Wyclif elaborates an interesting, if perhaps impractical, theory of lordship or dominion (civil, ecclesiastical, and "evangelical") that has its sanction in grace, a theory that has no echoes in the lines of Piers Plowman. Both writers are at one, however, in their insistence on the moral obligations of lordship and the holding of property.

With regard to the relations of church and state Wyclif boldly, and Langland in only a muted voice, advocate the expropriation by the Crown of religious temporalities. Both men point, too, to the possession of temporalia as the root cause of ecclesiastical abuses.

Microfilm $6.10; Xerox $21.20. 479 pages.

A STUDY OF SHAKESPEARE'S COMEDIES.

(L. C. Card No. Mic 59-4661)

Janet Bell Stamm, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Matthias A. Shaaber

The encompassing concern of this study is the question, what is drama? Three major periods of western drama--Greek, Elizabethan, modern--begin to define the limits within which the study of Shakespear's comedies is undertaken. Unlike Greek drama, which developed into separate kinds--tragedy or comedy--Shakespeare's plays are mixed. The problem therefore is an analysis that might account for both the "tragedies" and the "comedies" and for the "histories" as well. Is there a basic structure of Shakespearean drama? If we had such a study, we would then have two studies comparable in scope and method: Aristotle's Poetics on Greek tragedy and X's criticism on Shakespearean drama. Comparison of their results might then allow definition of drama to include both the kinds of Greek plays and Shakespeare's mixed plays. To begin any sound generalizations about drama, however, we should have no fewer than three such studies, one for each of the three major periods of western drama. Thus, a study of Shakespeare's comedies alone is an imperfect study; it assumes no more than that its methods and perhaps some few tentative definitions may make the case for the re-examination of Shakespearean drama as a whole.

The primary method is inductive because, first, there is no prevailing orthodoxy of general or of dramatic criticism from which to start, and, second, as the hypothesis assumes that neither "tragedy" nor "comedy" has been unequivocally defined, the definition of the elements of Shakespeare's plays must be derived from the plays themselves. The fourteen plays listed as comedies in the first folio are the plays of this study.

General procedure follows the chronology; such a procedure allows definition of elements in their germinal form. However, individuality of plays, like individuality of character, creates a condition virtually defying category and requires a combination of methods and procedures perhaps best described as a kind of critical cyclotron.

Definition begins with simple theatricalism. This is contrasted with dramatic meaning, such meaning, however, being a compound (as in geometric progression) of the theatrical. The mechanism of the physical jest defines the pattern of contrariety-to-expectation as the basis of Shakespeare's typically non-derisive laughter. Analysis of the Shakespearean play as a form reveals a triad of elements--chronicle, character, and what-is-said--as dynamic dramatic elements and the basis of the derivation of meaning. Since the plays move increasingly toward complex development of the element of character, definition of character begins with an assumption of the validity of every man--whether hero or buffoon--and shows the hero of comedy (like the hero of tragedy) as a being endowed with rationality and made responsible for his own story. The hero, consequently, is also a being endowed with the moral force to create his world on a scale beyond tragedy.

The structure of the late comedies is parable-like. The elements are those of the classic "fall" of the Judeo-Christian myth and the cognate Greek myth of Prometheus. The late comedies pose moral dilemmas whose resolution occurs on the supra-rational plane of compassion, understanding, love; the triumph of the late comedies is the creation of plausible, consequently real, people who act upon the rare but possible possession of self knowledge and irrefrangible love. The Tempest is an enactment of the delicate paradox of good and/or evil, tragedy and/or comedy "In yours and my discharge. . . ."

The simple conclusion of the study is that the comedies cannot be significantly handled alone. It also implies that the next significant development of drama, the modern, seems to derive from Shakespeare's drama rather than from Jonsonian social comedy. It also returns to the original question, what is drama? As Dr. Johnson wrote: "What I have here not dogmatically but deliberately written, may recall the principles of the drama to a new examination."

Microfilm $2.00; Xerox $6.80. 141 pages.

AWFUL RULE, AND RIGHT SUPREMACY: THE PROBLEM OF AUTHORITY AND ORDER AS A THEME OF SHAKESPEARE'S PLAYS.

(L. C. Card No. Mic 59-4999)

John Francis Sullivan, Ph.D.
University of Michigan, 1959

The political relevance of Shakespeare's plays, depreciated or denied in the nineteenth century, is now widely acknowledged, but it has not yet been satisfactorily interpreted. Extant criticism--typically confining itself to a limited number of plays, to the explicitly political domain, and to illustration from the plays of orthodox Tudor political ideas--has concluded that Shakespeare complaisantly accepted the argument of Tudor apologists that only absolute authority could withstand the menace of disorder. This study proposes a revision of that conclusion, based on these distinctive contributions: 1) an analysis of the complete canon of Shakespeare's plays, 2) an integrated treatment of the analogous spheres of domestic and political authority, and 3) a new perspective on the sixteenth century background of ideas and events.

Political ideas and events of Shakespeare's time are shown to reflect a dual heritage: the "Whig" doctrine of the medieval schoolmen, espoused, after the middle of the century, alike by Catholic and Puritan dissenters; and an absolutist attitude, reinforced by the influence of Machiavelli and the teachings of the Reformers. The rise of a new "naturalism" was attended by an apparent spread of moral disorder. The demand for unquestioned obedience was a reaction to growing restiveness, just as, on the domestic plane, insistence on masculine authority increased at the same time that women won new freedom.

While Shakespeare's plays do not promulgate a particular set of political ideas, they could hardly fail, in this context, to concern the problem of authority and order. Disorder in Shakespeare's earlier plays is not so widespread that effective authority can not cope with it, yet Shakespeare does not present authority as the solution. He does depict the dilemma of the king, whose obligation to preserve civil order seems to require moral compromise. In the early plays, such compromise brings apparent relief, but as disorder deepens in later plays, invading

more and more fundamental human relationships, authority, too, becomes infected. Real authority, indeed, passes more and more to the amoral adherents of the new "naturalism," until all human authority comes to seem only a "dog in office." The later plays mitigate this image but do not negate it.

The conclusion reached by this study is that Shakespeare did not concur in the Tudor appeal to authority against disorder. Instead, his plays imply that order must come first. Authority is not simply a less painful alternative to disorder but, ideally at any rate, a good which is itself a component of order. In man's fallen state, some degree of disorder is inevitable, but human authority is itself fallible, and, as disorder increases, such authority must also be corrupted; it cannot, therefore, cure the disease. Informing all of Shakespeare's plays is an ideal of all things harmoniously ordered, in a pattern appointed by immutable law. In this right order, the proper image for human authority is not a "dog in office," but the perfect Authority of God.

Microfilm $5.50; Xerox $19.40. 432 pages.

ARTISTRY IN TROILUS AND CRISEYDE: A STUDY OF CHRONOLOGY, STRUCTURE, CHARACTERIZATION, AND PURPOSE.

(L. C. Card No. Mic 59-4299)

Louis Felsinger Thompson, Ph.D.
Lehigh University, 1959

This study of Troilus and Criseyde presents conclusions about Chaucer's artistic methods in writing the poem (methods discernible in his other works as well) and the central purpose or controlling principle that determined the way he wrote it. These conclusions are inductively derived from internal evidence; from a comparison of Troilus and Criseyde with its source, Il Filostrato; and from a survey of critical commentary. An appendix to the dissertation proper offers verbal and other parallels that suggest Chaucer adapted more portions of the Filostrato to his own use than has previously been noted.

The evidence points insistently to the fact that Chaucer abstracted from Il Filostrato the essential ingredients of a story of betrayed love and made them into a unified, balanced, and concentrated work in the tradition of the romance but so modified by Chaucer's realistic treatment as to emerge as a form distinctively his own. The evidence also shows that Chaucer was primarily interested in the artistry of writing an effective poem that evoked appropriate reactions in his readers, not in following a literary formula or convention; not in provoking, discussing, or solving religious, philosophical, or moral issues; not in presenting realistically conceived characters and situations for the sake of being realistic. These and other elements are in the poem, but the poem does not exist for them; they are all subservient to Chaucer's art.

The fundamental artistic principle on which the poem is built is that of contrast, the contrast between the fun, the delights, even the uplifting moral consequences of the love between Troilus and Criseyde and the tragedy of Criseyde's betrayal of that love, with its aftereffects on Troilus. To this end, Chaucer worked in every way to glorify the love and to highlight the betrayal--though many critics have said he minimized it. He used chronology to emphasize Criseyde's violation of her deadline. (Despite many allegations to the contrary the poem is not based on a carefully worked out calendar, nor on any kind of calendar. Chronology is simply a tool that Chaucer used with unblushing promiscuity: here his accuracy is microscopic; there his indifference is wanton.) He created a structure that permits a build-up of the love to the high point of the consummation scene right in the middle of the poem and then a falling action climaxed by the betrayal and concluded with Troilus' death. He made the three major characters the moral and intellectual superiors of their counterparts in the Filostrato so as to put the amorous attainments of Book III on as high a plane as human nature permits, and to make the betrayal more tragic, the lapses of virtuous persons being worse than those of the garden variety; and he made Diomede worse, to underscore the folly and wrong of the betrayal. He used the fiction of his role as narrator-commentator as a device to control the audience's reaction, posing as a wry and skeptical observer who whips up the fun in the first part of the poem and becoming a serious, dispassionate moral historian who refuses to judge harshly--though the facts are conspicuously damning--in the second.

There emerges also form this study much evidence to support the epithet "psychological realist" applied to Chaucer by Victorian critics, and often disparaged by later commentators. There really is no doubt about the matter; Chaucer's characters are realistic in the same way those of Homer, Shakespeare, and Fielding are. That is, though they were not created from post-Freudian knowledge, they are a well from which post-Freudians draw insight into human nature. Microfilm $2.40; Xerox $8.40. 183 pages.

STUDIES IN TWO NATURE POETS: WILLIAM WORDSWORTH AND T'AO CH'IEN.

(L. C. Card No. Mic 59-4581)

Pin Chow Tu, Ph.D.
University of Illinois, 1959

This dissertation has two objectives in view. First, to demonstrate the nearness of Wordsworth's poetry to some Chinese modes of feeling and thinking. Second, to trace a possible Chinese influence on Wordsworth through the intermediaries of Coleridge and Leibniz. Hence I have chosen, for a close comparison with Wordsworth, a representative Chinese nature poet, T'ao Ch'ien (A.D. 372-427).

I begin my research by quoting from Wordsworth's and T'ao's poems of nature to show their prime concern with the world of eye and ear. Although most of the poems of Wordsworth are permeated with Christian sentiment, and the poems of T'ao with Confucian ethics, we unmistakably find in them the aura of a universal humanism which beacons to appreciative minds in every land. For there is in their poetry an ennobling moral conception of life as well as a sublime feeling for nature, both of which are essentially religious and deeply spiritual.

In the lives of all of us there will arise sooner or later tragic occasions that deeply perturb our souls. When human or even religious resources may prove of no avail

for our consolation, we can always turn, as did Wordsworth and T'ao, to nature for her beneficent powers to transmute our agonizing sorrows. Our communion with her silent, beautiful forms will not fail to create a tranquillity in our minds. For example, both Wordsworth and T'ao gained, during the moral crises in their lives, this tranquil restoration through nature assisted by love of family and friendship.

Wordsworth's philosophy of nature is an organic growth and has all the fascinating diversities of life itself. Thus there is the baffling variety of Wordsworthian criticisms, which can be roughly classified into two main schools: one which holds that there are two Wordsworths, the other, that there is only one. Now from the standpoint of Neo-Confucian organicism I should like to suggest that there could be as many Wordsworths as are conformable to the phases of his philosophical development, which are all equally important to the vital growth of the poet's mind. Without being exhaustive, we may enumerate these phases as associationist, naturalistic, pantheistic, Neo-Platonic, animistic, humanistic, stoic, and Christian. But there is in Wordsworth's poetry, as also in T'ao's, the central theme of the universal human experiences, such as his mystical feelings in visionary loneliness, his sublime excursion into cosmic infinitude, and his deep faith in the spiritual kinship between man and nature.

Furthermore, to Wordsworth's conception of an active principle which impels and rolls through the universe and to his exaltation of children, women, and peasants we find very close parallels in Confucianism and Taoism. Wordsworth's belief in the essential adaptability of man and nature and in the mind of man as the mirror of nature is akin to Leibniz's theory of the monad, which was influenced by the Neo-Confucian philosophy of organicism through the Jesuits. Therefore Wordsworth's approaches to mysticism, expressed in "Tintern Abbey" and The Excursion, are similar to T'ao's, as is evident in the light of Confucian Doctrine of Central Harmony.

All this accounts for certain peculiarities of Wordsworth's thought, which are in fact related to the "associative thinking" of the ancient Chinese mind. In this Chinese way of thinking, concepts are integrated in an organic pattern, signifying closely related parallelism rather than logical causality, so that both the objective phenomenon and the subjective state of the observer are harmonized into a steady whole--the manifestation of Tao or Li or, as Wordsworth terms it, "the life of things" that is deeply interfused in nature and in the mind of man.

Microfilm $3.30; Xerox $11.20. 254 pages.

OWEN WISTER AND THE AMERICAN WEST: A BIOGRAPHICAL AND CRITICAL STUDY.

(L. C. Card No. Mic 59-4584)

George Thomas Watkins, III, Ph.D.
University of Illinois, 1959

The object of this study is to examine the western experiences and writings of Owen Wister, to discover the familiarity the author had with the region, and to evaluate his performance.

Wister's western writings are considered in chronological order so as to show the growth of the artist. The six western books serve as major divisions, and each division is introduced with pertinent biographical information.

The study opens with a sketch of Wister's life prior to his first trip West in 1885. Wister is shown to have been a frustrated composer. The nature of his illness which necessitated the first western trip is hypothetically established as a nervous disorder induced by personality conflicts between son and father.

The study proceeds with a review of Wister's western experiences of 1885 through 1892, and continues with an analysis of the formulative influences upon Wister's literary career--chiefly those of Howells, James, Harte, Kipling, Twain, Henry Alden, Mary Hallock Foote, and Theodore Roosevelt. In the light of the above his first four western stories are examined.

After his first four stories, Wister continued to make trips West, now under contract with Harper's for a series of stories which were collected in Red Men and White and which Wister labeled "footnotes to history." The study of these stories evaluates their historicity as well as their literary merit.

All the components of Lin McLean were first published as short stories, but the study shows that the work is actually a carefully planned episodic novel exhibiting growth of character and enlargement of theme with each episode. The models for the title character are identified, as are many events upon which episodes were based. Lin McLean, rather than the Virginian, is shown to be Wister's more representative cowboy.

The Jimmyjohn Boss, Wister's third western book and second collection of short stories, is treated in the manner of the earlier stories. The central characters and events are identified, where possible, with actual persons and events. The collection is shown to be inferior to his first group.

The study concentrates upon the popularity of The Virginian, its misinformed critics, and the body of legendry it has engendered. The chapter shows the Virginian to be a composite character, drawn partly from actual persons and partly from imagination, and that the action belongs to central Wyoming. It reveals the method of composition, and indicates that Wister made extensive use of folk-lore in his most famous work. The study argues that The Virginian is superior to most western fiction, not for its action or its love interest, but by virtue of its moral and ethical conflict. While not a first-rate novel, it is as good as any western fiction of its day.

The review closes with an evaluation of Wister's last two collections of short stories: Members of the Family and When West Was West. The later stories reveal that Wister's artistry improved with the years.

The conclusion drawn from the study is that Wister's greatest value lies in the panoramic view of the West of his day that his work as a whole provides.

Microfilm $5.90; Xerox $20.60. 463 pages.

LANGUAGE AND LITERATURE, CLASSICAL

A STUDY IN LATIN PROSODY: SHORT FINAL VOWEL BEFORE INITIAL CONSONANT GROUPS COMPOSED OF STOP AND LIQUID.

(L. C. Card No. Mic 59-4610)

George Tobey Davis, Ph.D.
University of Pennsylvania, 1959

Supervisor: Henry M. Hoenigswald

Conflict between Latin phonemic structure and Greek metrical tradition caused Latin poets after Terence to avoid word-final short vowel before s plus consonant. A minor conflict of similar nature might be expected to exist for word-initial consonant groups composed of stop and liquid, since Greek metrical usage allows positional length whereas older Latin usage does not.

This study contributes to the investigation of the extent to which word-final short vowel is avoided before stop and liquid. It is accomplished by appropriate sampling from the works of the eleven foremost Latin writers of dactylic and elegiac verse from Lucretius to Juvenal.

It develops that the poets' treatment of this matter was not random. Little, if any, tendency to avoid the combination is seen, for instance, in Ovid's hexameters or in Propertius. On the other hand, such a tendency is very noticeable in Vergil, Catullus, Persius and Juvenal. Horace in his Satires (but not in the Epistles) and, to a lesser extent, Martial seek rather than shun the combination. This surprising result is probably not unrelated to the fact that Horace's Satires--but again not his Epistles--contain the relatively highest number of short scansions for final short vowel before initial s-cluster (and no long scansion of a significant kind), while the one line in Juvenal in which a final short vowel occurs before an s-cluster shows long scansion. Microfilm $2.00; Xerox $3.00. 25 pages.

LANGUAGE AND LITERATURE, LINGUISTICS

LARYNGEAL PROBLEMS IN INDO-EUROPEAN PHONOLOGY.

(L. C. Card No. Mic 59-2572)

Voldemars T. Bernards, Ph.D.
Columbia University, 1959

In the first part of this work we present an historical survey of the evolution of the laryngeal theory.

There exist different versions of the interpretation of the laryngeal problems but all share two basic hypotheses.

The first is that the Hittite phoneme or phonemes transcribed as ḫ-, -ḫḫ-; ḫ-, -ḫ- represent one or more PIE laryngeals which were lost or modified in all other IE languages.

The second is that certain phenomena of vocalism in IE languages represent reflexes of these phonemes.

In the second part we deal with specific laryngeal problems in PIE phonology.

Basing on the Hittite evidence we may assume that probably three PIE laryngeals were represented by Hittite ḫ. They survived in certain positions and remained, at least two of them, distinct in pronunciation in medial word position. Each of them had been lost in certain other positions in Hittite. In some words probably ḫ may be derived from PIE dorsals, and many loan-words of non-IE origin contain ḫ. Hittite ḫ seems to be a stable and frequent phoneme with distinctive value like any other phoneme in the language. It appears in all word positions and there is no evidence in Hittite that it was not inherited and that it was introduced secondarily in the language.

Beside Hittite in some other so-called "marginal" IE languages of the extreme southern belt of the IE linguistic area, which was in a direct linguistic contact with non-IE languages possessing laryngeal phonemes, we may find some laryngeal remnants still preserved in consonantal function. We may also assume that in some cases -k- developed from the coalescence of two laryngeals under certain phonological circumstances.

The absence of palatalization of kh in Sanskrit as well as the variety of development of PIE clusters consisting of voiceless stop plus laryngeal in the other IE languages support the conclusion that ph, th, kh were phonemes only in Indo-Iranian and not in PIE.

Laryngeal combinations with semivowels i̯ and u̯ (*Hi̯, *Hu̯) provide us with sound explanation of apparently irregular phonological developments such as the Greek initial voiced dental affricate z- corresponding to the Armenian j- under the same phonological conditions, etc.

With the help of the laryngeals we are able to some extent to account for such problems as so-called "original long diphthongs and long sonants", shwa "indogermanicum", "prothetic" vowel in Greek and Armenian.

In the IE languages laryngeals are associated with changes in both the quantity and quality of vowels.

The evidence presented in this work prescribes a strictly consonantal function for PIE *H. The ablaut grades are: ᵉ/ₒH- : H-. The differing forms of zero grade syllables represent not different basic ablaut results but individual "remedies" applied to the phonetic difficulties presented by the consonant clusters left by the regular apophony: simplification of consonant clusters, suffixation, insertion of anaptyctic vowel, restoration of original ablaut vowel, direct sonantization of a consonant.

Finally the origin of the Balto-Slavic intonation system may be explained on the ground of the laryngeal theory.

Microfilm $2.05; Xerox $7.40. 156 pages.

A PAPAGO GRAMMAR.

(L. C. Card No. Mic 59-4009)

Kenneth Locke Hale, Ph.D.
Indiana University, 1959

This dissertation is a structural statement of Pima-Papago, based on two summers' field work with informants living, as their ancestors lived, in Arizona and Sonora, Mexico, centering around Sells, Arizona. In scope, the

analysis ranges from phonemics to morphology-syntax, as follows.

Phonemics treats first the suprasegmental phonemes whose inventory includes phonemic stress and two junctures of which one marks contour boundaries and the other marks phonemic pitch shift within the contour. The inventory of the segmental phonemes includes 19 consonants, 5 vowels each of which distinguishes length.

Morphophonemics treats the more productive alternations which are phonologically determined, and distinguishes these sharply from others which depend for their shape on morphology, or else, though stateable in terms of phonology, are by no means productive. Morphophonemes—special notations—are employed in the treatment of productive alternations, together with a corpus of rules; the latter, without special notation, suffice for the exposition of the less productive alternations.

The major stem classes of Papago are shown to be verbs, nouns, and attributes—$\underline{V}$, $\underline{N}$, $\underline{A}$ respectively; the minor stem classes are pronouns, spatials, and quantifiers—$\underline{P}$, $\underline{S}$, $\underline{Q}$ respectively. An interesting textual-statistical-lexical difference is observable between the major and minor stem classes. The former appear in high numbers in total count—in the list which will form the basis of the dictionary—but any particular item from the former is infrequently encountered in any text. For the latter the converse can be said: low numbered in total count but highly frequent in any particular text.

Members of the three minor stem classes are treated according to their occurrence in combination with affixes. In addition, morpheme sequences are treated in which members of some of these minor stem classes co-occur with members of certain of the major stem classes. The main emphasis of the thesis, however, is morphological rather than syntactic. Divisive features are noted not only for the major and minor classes as already noted, but for subclasses of these. Both are determined according to the combinatorial possibilities between stems, such subclasses as $\underline{V}_1$, $\underline{V}_2$, $\underline{V}_3$, for example, and two kinds of affixes (prefixes and suffixes) on the one hand, and two kinds of operators (cancellation and reduplication) on the other hand. Members of the large class of verb stems are subclassified according to their combination with one or more of a set of affixes (suffixes and prefixes) and operators having reference to such categories as tense and aspect. Subclasses established in this way are further subdivided according to combinatorial possibilities with affixes and operators having reference to the categories of person and number. Members of the large class of noun stems are subclassified according to their function in one or the other of two possessive paradigms contrasting as alienable : inalienable possession. Members of the class of attribute stems are similarly subclassified according to combinatorial possibilities.

Microfilm $2.45; Xerox $8.60. 188 pages.

SELECTED PROBLEMS OF BILINGUALISM AMONG IMMIGRANT SLOVAKS.

(L. C. Card No. Mic 59-4959)

Goldie Ruth Piroch Meyerstein, Ph.D.
University of Michigan, 1959

This thesis applies principles of modern linguistic science, and more particularly of recent studies in bilingualism, to the description of some speech features characteristic of Slovak immigrants in the United States. This description is the result of the analysis of tape records and other recordings made of the speech of twenty-two speakers deemed representative of their speech communities. The informants interviewed are residents of Binghamton (Southern Tier of New York State) and the Chicago area, two of the major centers of Slovak immigrant settlement in America.

Attention in this study centers on deviations of Immigrant Slovak from the norms of Standard Slovak, but the investigation also extends to European Slovak dialect traits, and to English as spoken by Slovak immigrants. The linguistic behavior of the interview subjects is reviewed against the background of their cultural and historical traditions. The linguistic aspects of Immigrant Slovak speech are compared to the findings of similar studies previously undertaken in other areas, e.g. American Norwegian, and of descriptions not specifically linguistic in such areas as Immigrant Czech.

The basic features of language interference demonstrated in this dissertation are in the nature of homophonous, synonymous, and homologous diamorphs, and assimilated versus unassimilated loanforms. Assimilation of forms borrowed into the speech of Slovak immigrants is studied in terms of types and degrees, and subjected to statistical tabulation of relative incidence of language interference for first and second generation immigrant speakers. The grammatical areas spotlighted in this investigation are the formation of words, prepositions, noun case forms, and function words of the article-type. The study of these various areas is accompanied by a discussion of problems of evaluation and interpretation of data and findings.

Among the most noteworthy conclusions from this study is the progressive loss of Standard Slovak grammatical (case) and lexical (word-choice) distinctions in Immigrant Slovak, and the loss or hypercorrective "misuse" of English distinctions in Slovak immigrant usage.

This study, it is hoped, will be a contribution to the non-immigrant's understanding of the immigrant's language features and their communicative significance and, through the comprehension of the immigrant Slovak's speech patterns, to the appreciation of his cultural traditions and his way of life.

Microfilm $2.70; Xerox $9.40. 208 pages.

THE OLD SAXON VOWEL PHONEMES UNDER MEDIAL AND WEAK STRESS IN THE M MANUSCRIPT OF THE HELIAND.

(L. C. Card No. Mic 59-4733)

Frederick William Oppermann, Ph.D.
The University of Texas, 1959

Supervisor: Dr. W. P. Lehmann

This dissertation is a descriptive analysis of the system of vowel phonemes not under primary stress in the M manuscript of the Old Saxon poem, the Heliand. A metrical analysis of the Heliand indicates that, in addition to a primary stress level, there are also medial and weak levels of stress.

Comparison of the orthography of vowels under medial stress with the orthography of vowels under primary stress and the evidence provided by comparative grammar are used to isolate 13 probable vowel phonemes under medial stress, /i ī e é a ā o ó u ū eu ia iu/. These probable vowel phonemes are presented in submininal contrast as support for assuming their phonemic independence.

The scribe of manuscript M represented the vowels under weak stress by using graphs or variations between graphs from 5 homogeneous graphemic concatenations. These 5 graphemic concatenations are assumed to be representations of 5 vowel phonemes, /i e a o u/. Minimal contrast of these 5 vowels is presented as support for assuming their phonemic independence. The contrasts are as follows:

	/i/			
/e/	sagdi M129 sagde M1333	/e/		
/a/	egin M1955 egan M1856	gibioden M895 thiodan M4630	/a/	
/o/	handi M4917 hando M4517	dages M515 dagos M4131	berad M4661 uuerod M620	/o/
/u/	egin M1955 egun M1348	mude M3934 mudu M165	egan M1856 egun M1348	godo M930 godu M4211

Four appendices list and classify the materials from which the above conclusions were drawn. Appendix A lists alphabetically all words which are the specific field of this study, exactly as they occur in the M manuscript. Appendix B list by roots all words which have a syllabic nucleus under medial stress. Appendix C lists base morphemes under weak stress. Appendix D lists the prefixes and suffixes under weak stress, inflectional as well as derivational.

Microfilm $6.10; Xerox $21.20. 480 pages.

THE GRAMMATICAL HIERARCHY OF ISTHMUS ZAPOTEC.

(L. C. Card No. Mic 59-4970)

Velma Bernice Pickett, Ph.D.
University of Michigan, 1959

Isthmus Zapotec is a language spoken in the state of Oaxaca in southern Mexico. Data for this study were gathered by the writer during field trips to the town of Juchitán, Oaxaca, during the winters of 1943-50, 1951-56.

The grammatical structure of the language is presented in terms of a hierarchy of six structural levels, ranging from highest (most inclusive) to lowest (least inclusive) as follows: Discourse, Utterance, Sentence, Clause, Phrase, and Word.

An introductory section includes an introduction to the model used for the presentation of the materials--an adapted form of the tagmemic model based on the theory set forth by Kenneth L. Pike in his book Language in relation to a unified theory of the structure of human behavior. The structures at each level are viewed as composed of slots filled (most frequently) by structures of a lower level. This unit composed of a slot and its filler is called a tagmeme.

Section 1 presents the hierarchical structure in preview, giving the contrastive features of each of the levels, i.e., showing how they contrast one with the other in internal composition and in distribution.

Section 2 presents the details of the internal structure at each level of the hierarchy. Each level includes "classes," "subclasses," and "types" of structures. Each type is described in detail, with descriptive name (such as "declarative intransitive," a type of clause), formulaic representation, and illustrations.

Section 3 discusses in detail some of the theoretical problems involved in the analysis and the use of the tagmemic model. Pike's original concept of the tagmeme was as the minimum unit of the grammatical hierarchy. Basic to the concept was the requirement that for any slot-class correlation to be considered a tagmeme the slot must at some time be filled by a single morpheme. Under this requirement, most of the units which are called predicate tagmemes in the Isthmus Zapotec analysis would not be tagmemes, but hypertagmemes, since these predicate slots are filled by verb forms which include bound stems with obligatory affixes.

The adaptation of the theory to ascending levels of structure was first suggested by Robert E. Longacre. In this model, as each level (such as word, phrase, clause) becomes the focus of attention, the tagmeme has a different kind of slot-filler correlation. Tagmeme, then, becomes a relative concept rather than an absolute one.

The present dissertation is the first attempt to test the Longacre modification of tagmemics in the analysis of a language at all levels from phrase through discourse. In applying the theory and procedure to Isthmus Zapotec, two further adaptations were made.

(1) New criteria were used for determining structural levels and types.

(2) A new approach to classification was found necessary. The result is a combination of some features of the traditional mutually exclusive groupings of stems based primarily on distribution with affixes; and the distribution classes of Pike, which are overlapping groups of forms

(small and large together) determined by their occurrence in a particular slot. Zapotec word classification was made by means of the two criteria of external distribution and internal structure, with distribution ranked as primary. The primary division is in terms of partially overlapping distribution classes, determined by diagnostically- differentiating slot occurrences. Internal-structure differences are treated as subclasses.

Section 4 is a bibliography including studies regarding various dialects of the Zapotec language and theory and presentation of syntactic analysis.

Microfilm $2.70; Xerox $9.40. 206 pages.

THE GRAMMATICAL STRUCTURE OF BANGRU.

(L. C. Card No. Mic 59-4658)

Jag Deva Singh, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Henry M. Hoenigswald

This study pertains to a synchronic analysis of the structure of Bangru — a dialect of the Western Hindi, spoken in the south-east region of the Punjab State, India and belongs to the Indo-Aryan family of languages. I have acted as my own informant.

The description is divided into three main sections: Phonology, Morphology and Syntax.

The segmental phonemes are: p t ṭ c k ph th ṭh ch kh b d ḍ j g bh dh ḍh jh gh m n ɳ n̄ s r l ɾ ḷ y w h i ɪ e æ u v o ɔ ɨ ʉ ə a. The suprasegmentals are: three pitch levels 1 2 3, four terminal contours, level→, rising ↑ falling ↓ , and low rising ↗ , and four junctures, #, * and external open juncture marked by space.

The segmental phonemes neatly divide into consonants and vowels. / y w / although in complementary distribution with / ɨ ʉ / respectively have been set up as separate phonemes for structural reasons. The alternative was to set up semi-vowel as a separate class. Vowels in sequences have generally no diphthongal character and consonants (particilarly stops) are fully released in clusters.

All vowels occur as nasalised. Distributional limitations can be described in terms of the two classes of vowels: long and short. Short vowels do not occur finally. Among consonants flaps / ɽ ɭ ɾ / and / n̄ / do not occur initially. There are certain restriction on their co-occurence in clusters.

Morphphonemic statements on the whole are simple. Vowels in the root show almost very regular alternations before certain suffixes. Numerals and pronouns have many and unique alternants.

Word derivation is by means of prefixes and suffixes. These have been described exaustively.

The word classes, nouns, pronouns, adjectives, adverbs, verbs, auxiliaries, postpositions, conjunctions and interjections have been defined by morphologic and syntactic criteria. Nouns (adjectives and adverbs of certain classes) and verbs are inflected for certain grammatical categories. A separate section describes the grammatical categories and concord.

Features of compound formation overlap with phrase structure. In certain cases it is hard to decide on structural basis. However I have attempted to base it solely on formal grounds. In certain cases it may not be very convincing. For instance I have altogether different reasons to treat compound verbal stems under phrases.

The last section deals with syntax. I have assumed that the structure of varied sentences in the dialect can be described in terms of the structure of very few sentences (only six for Bangru). These are called kernels. After having explained their structure I have proceeded to state various transformational rules through the application of which all other sentences in the dialect can be obtained. I do not claim to have exausted all the possible transformations but I am confident that I have not missed any important one.

In the appendix is given a sample text in phonemic transcription with English translation.

Microfilm $2.85; Xerox $8.20. 179 pages.

LEXICAL EXPANSION DUE TO TECHNICAL CHANGE: AS ILLUSTRATED BY THE ARABIC OF AL HASA, SAUDI ARABIA, DURING THE DECADE 1938-48.

(L. C. Card No. Mic 59-2598)

B. Hunter Smeaton, Ph.D.
Columbia University, 1959

On the basis of lexical data gathered in the field between 1945 and 1949, the author analyses, from a sociolinguistic viewpoint, the incorporation of a vast body of new vocabulary into Hawawi Arabic, the language of a people practically untouched by modern industry before the discovery of oil on the Persian Gulf coast of Saudi Arabia in 1938. An introduction (Part I) is devoted to the statement of definitions and scope, a description of the local population and their way of life prior to the coming of the Americans and a summary account of those aspects of Hasawi Arabic structure relevant to the exposition, the reader being thus prepared for the lexical findings which form the body of the dissertation (Part II). Under "Scope," four approaches to the study of lexical change are distinguished, depending upon whether the stimuli thereto are of intra- or extracultural origin and whether lexical change is a by-product of cultural change ("onomasiological approach") or of linguistic change ("semasiological approach"). In these terms, the study is concerned with lexical change due to cross-cultural innovation and stands apart, then, for example, from the more exclusively linguistic approaches of Gilliéron and Dauzat ("lexical change due to intralingual structural change") and of Weinreich and Haugen ("lexical change due to contact between languages"). The question is asked: Why should particular material innovations to the culture have received the names they did? Thus, the concern is not so much with De Saussure's interpaired signifiants and signifiés as with a given culture's treatment of what the author has called "signifiables."

Part II is basically divided into the analysis, on the one hand, of borrowings from other languages (principally American English, but also earlier borrowings from Persian, Hindustani, et. al., by way of corroboration of general findings), and on the other, of semantic extensions of indigenous Arabic vocabulary to new uses. In the case of borrowings, three well-defined degrees of integration are

found, on the basis of their morphological attributes. Indigenous extensions are classified according to designation by appearance only, designation by function only and designation by general identification of the innovation with a previously known referent. Special chapters are also devoted to compound designations and circumlocutions and to non-Hasawi Arabic introduced by Hijazis and others, on the colloquial level, and the standard Arabic terms deriving especially from written sources (reports, bulletins, etc.).

Part III ("Summary and Conclusions") is concerned with the analysis of the total findings in terms of cultures in contact. From the standpoint of word-field theory and kindred approaches to the analysis of lexical structure, an examination is made, on the basis of the foregoing material, of the diachronic process whereby an ideal state of "lexical adjustment" is achieved, and suggestions are made as to how the process could be controlled and much social waste avoided. Attached, besides the bibliography, are an appendix entitled "Hasawi Arabic Treatment of English Phonemes as Evidenced in Borrowed Vocabulary" and an index of Hasawi colloquial terms cited.

Microfilm $3.40; Xerox $11.60. 261 pages.

THE PHONOLOGY AND MORPHOLOGY OF THE SUNDANESE LANGUAGE.

(L. C. Card No. Mic 59-5003)

Wayland Bryce Van Syoc, Ph.D.
University of Michigan, 1959

The purpose of this study is to analyze and describe the phonological and morphological structures of the Sundanese language as it is spoken in the Krawang and Southern regions of Pasundan, West Java.

The corpus used for the description consisted of transcribed notes made during a period of residence in Java from 1953-1956. The speech of three informants, two from Bandung in the Southern region and one from Tjikampek in the Krawang region to the north, was recorded in phonetic symbols either directly as the informants spoke or from taped records of their speech. The language of the two areas proved to be structurally the same, the differences observed being matters of style only.

The introduction deals with the historical and linguistic backgrounds for the Sundanese language, which belongs to the Malay branch of the Malayo-Polynesian family of languages. The discussion includes the influences other foreign languages have had upon Sundanese.

Phonemes and morphemes were isolated by discovering sounds or units of sound sequences which contrast in identical or analogous environments. The structures of the wordlike elements or lexemes were determined by using immediate constituents. Although the study does not include an analysis of the syntactic structure of the language, syntactic frames were used to classify lexemes into four mutually exclusive classes: verbs, nouns, adjectives, and particles.

The analysis revealed seven vowels and nineteen consonants, two of the latter being semivowels. A definite structural system was discovered in which phonoemes are combined into sequences which comprise lexemes. Intonation and pause proved to be structurally significant, but stress and juncture proved to be nonphonemic.

An analysis of the data revealed six different types of morphophonemic changes, which are described. These relate to nasalization in verbs, fusion of sounds, loss of sounds, pluralization of root morphemes, and doubling of certain roots.

The lexemes of Sundanese are divided into fullwords, which can be substituted in the syntactic frames mentioned above, and particles, which can not be substituted. The particles are single morpheme units and are therefore not discussed. The fullwords are divided into verbs, nouns, and adjectives. The verbs and nouns have both inflectional and derivational systems. Inflectional endings are added to bases, which are composed either of simple roots or roots plus affixes. Verbs have transitive and intransitive inflectional systems. The transitive inflection includes three categories: passive, active, and imperative. Nouns have one inflection, which includes generic, specific, and indefinite categories. Nouns and verbs occur with both singular and plural bases. Adjectives, which are not inflected, also occur in singular and plural forms. Pronouns are a subclass of nouns and are inflected for person and number. The derivational system of verbs and nouns is also described.

The analysis of a sample text and a selected lexicon of items occurring in the data are included in the appendix.

Microfilm $2.45; Xerox $8.60. 188 pages.

LANGUAGE AND LITERATURE, MODERN

GASTON D'ORLÉANS ET SA COUR: ÉTUDE LITTÉRAIRE. [FRENCH TEXT].

(L. C. Card No. Mic 59-3984)

Claude Kurt Abraham, Ph.D.
Indiana University, 1959

In recent times, scholars have included, in their studies of seventeenth century literature, the so-called minor writers of that period. However, these writers have been treated as isolated and inexplicable phenomena. This study is an attempt to trace the history of a cultural milieu in which many secondary writers lived and wrote, and thus show that the works of these "écrivains oubliés", like those of their great contemporaries, were a product of a race, a moment, and a milieu.

The court of Gaston d'Orléans, younger brother of Louis XIII, was a milieu in which libertine writers lived side by side with the most conservative scholars of the time. Gaston did not dictate a mood to his followers, and therefore, a great variety of writers flocked to his court.

While Gaston was forced into the role of historic villain, he was a far greater patron of the arts than his brother. His life as a Maecenas can be divided into three periods: the first, from his birth in 1608 to his marriage in 1626; the second, from 1626 to his exile to Blois in 1652; the last, from 1652 until his death in 1660, the date which is usually considered the beginning of the classical period.

The first period is one of formation. Blocking all attempts by Gaston's supporters to elevate Gaston to a rank

worthy of him, Louis XIII turns his brother against him. Gaston, seeing himself cast into the role of traitor, decides to enjoy the role.

The second period is one of revolts and exiles. While Gaston, in his youth, had been inclined to deep studies, he now surrounds himself with libertine writers. Like many noblemen of his times, he liberates his milieu from the rules of the self-imposed legislators of Parnassus and of polite society.

The last period is one of resignation. From the political point of view, Gaston is a failure. He fails even in being an accomplished villain. As a result, life at his court loses all its spirit, and the writings reflect this loss. As far as society is concerned, Gaston is dead. Outdated, ill, Gaston turns to more sedate pastimes. The sciences, particularly botany, receive the largest part of his attention and supoprt.

From the personal point of view, Gaston has failed. Lacking the power of his convictions, he has been unable to distinguish himself. As a Maecenas, he has not been able to recognize the genius of his best writers, such as Tristan L'Hermite and Voiture, while protecting the more mediocre ones. For a long time, however, his mere existence was the justification of an entire literature which is the reflection of a movement that connects the sixteenth and the eighteenth centuries. It is in such a climate of irreverence that a young Voltaire was to acquire the tastes peculiar to him and to the other "philosophes".

Microfilm $2.65; Xerox $9.20. 203 pages.

FOCUS ON REALITY IN THE NOVELS OF ROBERT WALSER.

(L. C. Card No. Mic 59-4591)

George C. Avery, Ph.D.
University of Pennsylvania, 1959

Supervisor: Professor Adolf D. Klarmann

I

Detailed analyses of Walser's three extant novels, Geschwister Tanner, Der Gehülfe and Jakob von Gunten are undertaken in the belief that the themes, motifs and styles used in these novels comprehend Walser's spiritual and artistic range and anticipate the rest of his production in the twenty years after he abandoned the novel form in 1909. Praise of Walser by contemporaries such as Hesse, Morgenstern, Kafka, and Brod, the paucity of critical attention shown Walser's work since the twenties, and my own conviction that he is an outstanding minor author seemed to justify such a study. The title refers simultaneously to the pedantic veracity Walser illustrates in his translucent descriptive writing, to the situation in the novels of these descriptions in such a way that they are recognizably reflections of the inner lives of the heroes, and, finally, to the tension created in the novels by the heroes profession or acceptance of insignificance and unhappiness ("das Glück des Unglücks") and the sprightliness, humor, and irony inherent in the writing.

II

In seeking to describe and explain the contrast between the inner richness and the external poverty common to the three heroes, the following procedure is employed: a resumé and discussion of pertinent criticism on the individual works is given; a close reading of the texts provides a basis for analyses of the principal characters; interpretations of the evidences of the heroes' loquacity, their interior monologues, their dreams and fantasies are represented as the elements that bind together the narratives of these novels which are characterized by sparse plots. These interpretations also note the use by Walser of juxtaposition and submerged metaphor and are read as the interpolations and commentary which he otherwise omits. Because Walser so frequently uses autobiographical material in his novels, care is taken to concentrate attention on them as creative works. Walser's style and form are regarded as organic elements of the novels, indispensable for an understanding of the heroes and Walser's artistic intention.

III

Walser's three youthful heroes are outsiders and self-seekers who are to achieve acceptance by the world through self-restriction. They seek grace by affirmation of the plurality of the world. Of the three novels, only the second one approaches the traditional novel. This fact is interpreted as an extension of the hero's character in that work. All three lack a clear resolution; the third novel presents an ontological purgatory in the form of a questionable school that teaches service and de-personalization of the individual. Throughout the novels there is evident an increase in irony vis-à-vis author and hero and hero and reality. The disuse of the heroes' capacities and their subsumption is not undertaken out of concern for the social or political structure, as was often the case in the German novel of the 19th century, but out of an existential need. The heroes' humility derives from but is independent of Christian ethics. Although keenly receptive and vigorously aphoristic, the heroes stress the non-rational.

IV

The fifth chapter of the dissertation considers the rest of Walser's writings briefly emphasizing the reappearance and modification of styles, themes, and motifs found in the novels. The conclusion discusses the modernity of Walser's work and the increasing complexity his style underwent while his thematic range was becoming narrower and more abstracted.

Microfilm $3.00; Xerox $10.20. 230 pages.

MORITZ HEIMANN (1868-1925): CRITIC AND WRITER.

(L. C. Card No. Mic 59-4880)

Dirk Baay, Ph.D.
University of Michigan, 1959

No major critical treatment exists of the life and literary importance of Moritz Heimann, for many years editor and literary adviser of the S. Fischer publishing house in

Berlin. Aside from this phase of his career he established a reputation as a critic and writer. He published a hundred and fifty and more essays on literary, political, and other subjects. His creative writings include poems, aphorisms, six dramas, and a dozen Novellen. The dissertation consists of two parts—a biographical study and an analysis of his work.

Heimann entered the S. Fischer Verlag in 1895. His role in guiding the firm through the period of its greatest expansion, and his personal and professional assistance to many young writers must be considered the most significant part of his career. He developed close friendships with Gerhart Hauptmann, Hermann Stehr, Jakob Wassermann, Oskar Loerke, and Wilhelm Lehmann, and played an important role in their lives. Among the many other writers, critics, editors, and artists with whom he associated regularly were Otto Brahm, Julius Bab, Martin Buber, Rudolf Rittner, Walter Rathenau, Emil R. Weiss, and Renée Sintenis. Through these relationships and his wide reputation as a man of unusual literary insight, keen intelligence, wisdom, and moral integrity, Heimann exerted great influence on the literary life of his time.

Next in importance are the essays, most of which appeared in the Neue Rundschau and the Weltbühne. Their underlying theme is the dualistic nature of reality. The truths by which man lives can neither be absolute, nor solely determined by the conditions in which he finds himself. His attitudes and actions should be based on the dynamic tension between his unrelenting search for elusive absolutes and the necessity for positive, responsible action in spite of human limitations. Refusing to align himself with particular political groups, Heimann saw his primary function in questioning and challenging contemporary conditions, with due regard for historical precedent and traditional values. He was equally skeptical of rigid conservatism and radical, utopian thinking. In his literary criticism he was similarly eclectic, emphasizing the unique role of art in life as the only medium through which the essential unity of all reality can be experienced and all paradoxes reconciled. Rejecting the exclusive claims of particular movements such as naturalism and aestheticism, he sought to discover and promote individual talents and works of value, regardless of their origin.

Five of Heimann's dramas were performed on the stage, but none were popular successes. He was unable to achieve the complete integration of his significant themes with imaginative plots and convincing dialogue, due to a primarily analytical mind and philosophic bent. Although some of his dramas show a deep insight into human beings and their problems, and some have individually excellent scenes, he achieved greater artistic unity in his Novellen, some of which may be regarded as outstanding. The totality of Heimann's life and work should assure him a modest, but unique place in the annals of modern German literature.

Microfilm $3.25; Xerox $11.00. 250 pages.

THE THRILLER PATTERN IN THE MAJOR NOVELS OF GRAHAM GREENE.

(L. C. Card No. Mic 59-4883)

Bernard John Bedard, Ph.D.
University of Michigan, 1959

This study examines the problems faced by Graham Greene in adapting the pattern of the contemporary thriller, as exemplified in his entertainments, to present meaningful religious experience in his four major novels: Brighton Rock, The Power and the Glory, The Heart of the Matter, and The End of the Affair. The thriller pattern is first abstracted from his entertainments written during the same period as his major fictional endeavors, and then the evidences of that pattern are traced in each of the major novels to determine how much of the pattern is retained unaltered, to note what significant changes are introduced in each novel, and to evaluate the effect of the retentions and the innovations.

The Introduction discusses the particular problems posed by Greene's decision to treat spiritual problems in serious novels that are related structurally and thematically to his lighter diversions. Since the study focuses upon only four novels, an orienting survey of Greene's work is included in this section.

Chapter I treats first the nature and appeal of the thriller in general and clarifies the terms "thriller" and "pattern" as used in this study. The elements of the thriller pattern are the common features of Greene's most characteristic entertainments, particularly A Gun for Sale, The Confidential Agent, and The Ministry of Fear. Greene's thriller pattern is isolated through a composite analysis of the three entertainments. In brief, a pariah is pursued through a corrupt and violent world peopled by grotesques. The dual forces of the hunters close in upon him; his sense of justice causes him to rebel; the pursuit is reversed. The passive man becomes the avenger. The chapter concludes with a discussion of the work of certain writers of thrillers--particularly espionage thrillers--to demonstrate by contrast what is distinctive and what is conventional in Greene's handling of the thriller.

The four major novels are analyzed in the succeeding chapters. Chapter II traces the pattern as it is clearly discernible in Brighton Rock and notes the inadequacies of Greene's attempt to realize its symbolic potential by a procrustean imposition of an allegorical scheme of oppositions upon the narrative. Chapter III shows how the possession of a religious story in The Power and the Glory lessened the necessity for Greene to impose meaning but did not entirely prevent confusion between the methods of a thriller and the intentions of a legend. Chapter IV points out how Greene in The Heart of the Matter added to his account of the hunted and the pursuit psychological explanations of the process by which his hero becomes victim and thus shifts the interest from the physical level of the chase to the depiction of a spiritual struggle more effectively. In Chapter V The End of the Affair is analyzed to demonstrate how the pattern remains evident in spite of changes in Greene's narrative technique and the utilization of a more civilized locale.

Since the detailed results of the investigation are found in the analyses of the individual novels, the Conclusion is confined to generalizations about the nature and direction of the changes Greene made and to an account of the effect

of the elements of the thriller pattern that remained. The superiority of the later novels results more from Greene's more assured craftsmanship than from deeper spiritual insights. Where Greene has been successful he has demonstrated that the contemporary novel of intrigue can be used to create effects analogous to those of the medieval tale without losing the particular advantages it has to create suspense on the purely natural level.

Microfilm $3.25; Xerox $11.00. 250 pages.

THE METHOD OF ICONOCLASM IN GEORGE BERNARD SHAW.

(L. C. Card No. Mic 59-4888)

George Robert Bond, Ed.D.
University of Michigan, 1959

The purpose of this study is to show the recurrence of a characteristic pattern of argument in Bernard Shaw's iconoclastic tracts and prefaces. Shaw's way of arguing a case is marked by a method which is regular and about which he is frequently explicit. This method is justified (perhaps made necessary, in Shaw's terms) by the unfinished, "open-ended" universe which his Creative Evolution philosophy accepted as real.

The first four chapters of the thesis analyze, in order, (1) the preface to Man and Superman, (2) "Common Sense About the War," (3) The Adventures of the Black Girl in Her Search for God plus the preface to Back to Methuselah, and (4) Everybody's Political What's What? Produced over a span of more than forty years, these Shavian documents demonstrate the persistence of Shaw's characteristic method throughout the most significant and productive period of his long lifetime.

Chapter Five relates Shaw's method of argument to broad intellectual trends current in the epoch during which he produced his polemic. Shaw's vocabulary is that of the pragmatists (William James, John Dewey, et al.), of the "gestalt" psychologists, and of the philosophies which regard "process" and "purpose" as dominant shaping factors in cosmic affairs.

The sixth (and final) chapter of the study describes Shaw's success as a dramatist in terms of his method of argument. The habit of subdividing complex ideas into their component parts and placing emphasis upon some unexpected aspect to achieve an iconoclastic effect is a device well suited to the stage. Shaw allows separate characters in his plays to symbolize the various parts of whatever ideas he chooses to dramatize, and then proceeds to work out their conflicts and to recommend the restructurings he approves.

The conclusion one reaches from this analysis of his work is that Shaw regards the large problems of civilization as rooted in and emanating from man's tendency to cling to outworn ideas. It is therefore necessary, in Shaw's view, to distinguish the sterile ideas of the past from the seminal ideas of a changing present and future. Shaw's metaphor for this iconoclastic process is "throwing out the dirty water" of obsolete beliefs. Having once grasped this central operation in his program of reform, one can interpret Shaw's many-sided assault upon conventional attitudes in terms of a consistent method. At different moments in his career, Shaw was a conspicuous champion of socialism, totalitarian dictatorship, sweeping reforms in education, matrimony, and religion. All of his diverse positions were arrived at by way of the same method, however, which controls his recommendations from first to last.

Microfilm $2.40; Xerox $8.40. 182 pages.

THE AESTHETIC TRADITION IN THE ENGLISH COMIC NOVEL.

(L. C. Card No. Mic 59-4496)

Neil Francis Brennan, Ph.D.
University of Illinois, 1959

The refinement of the English novel in the past century has been accompanied by the emergence of the comic novel as an art form, and with it the birth of a new and vigorous, if minor, tradition in the novel. The lines of its development seem peculiarly cohesive, and it is only a slight oversimplification to consider Oscar Wilde the focal agent, despite the fact that he wrote no comic novel himself. His admiration for Meredith and James on the one hand, and for Lewis Carroll on the other, brought into happy conjunction two traditions, at least, and a handful of Wilde's friends put the ideas he preached into the practice of the novel. To his defense of aesthetic form, surrealist logic and a "tough" worldview, E.F. Benson with Dodo (1893), Robert Hichens with The Green Carnation (1894), Anthony Hope with The Dolly Dialogues (1894), Max Beerbohm with Zuleika Dobson (1896?-1911), and Ada Leverson with such novels as The Limit (1911) added refinements in technique (especially in dialogue and point-of-view) and created an aesthetic fiction, with the moral and emotional detachment requisite to an art that would be both deeply serious and unwaveringly comic. In the next decade "Saki" (Hector Hugh Munro) with The Unbearable Bassington (1912), Ronald Firbank with such novels as Caprice (1917), and Norman Douglas carried on this embryonic tradition, and between the wars Aldous Huxley, Evelyn Waugh and Anthony Powell brought it to critical prominence. Douglas and Huxley are somewhat awkwardly aligned here, of course, since both were also influenced by the comic novel of ideas associated with Thomas Love Peacock and since both quickly departed from the tradition; but their early novels South Wind (1917) and Antic Hay (1923) are their best novels and these present life with the detached fidelity typical more of the aesthetic than the Peacockian tradition. The attitude toward comedy and toward art of all of these novelists was formed, biographical analysis reveals, under the joint influence of family traditions and the ideas of the aesthetic movement of which Wilde was a symbol. Tentative correlation of biography and fiction also suggests more actuality behind their "farce" than is usually suspected, and examination of their critical writings shows clearly that more intellectual acumen structures their attitudes toward life than is usually admitted. The masterpieces were slow in arriving, yet with Evelyn Waugh's Vile Bodies (1930) and A Handful of Dust (1934) and with Anthony Powell's Afternoon Men (1931) and From a View to a Death (1933) the aesthetic tradition would seem to have established itself at least as securely as Restoration Comedy. Aristocratic in background, conservative in inclination, and relatively

non-satiric in mode, the novelists of this tradition ran counter to the proletarian, libertarian, and socially utilitarian literary trends of their time; yet the very similar Movement associated with Kingsley Amis and Lucky Jim in the 1950s suggests that this eccentricity may be more durable than was once supposed.

Microfilm $10.30; Xerox $36.60. 813 pages.

THE SOCIAL PLAYS OF SIR ARTHUR WING PINERO: AN OLD ANSWER TO A NEW QUESTION.

(L. C. Card No. Mic 59-4603)

Nathan R. E. Carb, Jr., Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. E. C. Bolles

It has been widely believed that because the plays of Pinero show obvious resemblances at many points to those of Ibsen, Pinero shared Ibsen's views on the place of women in society and that like Ibsen Pinero approved the conduct of his unconventional heroines. This is a fallacy.

It is the purpose of this dissertation to show from the evidence of the plays, successively examined, that Pinero and Ibsen could not have been farther apart in their standards for acceptable feminine conduct and of the validity of the social codes that subject women to so many more restrictions and penalties of their infraction than men.

A study of the plays from The Profligate (1889) through The Second Mrs. Tanqueray (1893) and Trelawny of the "Wells" (1898) to Mid-Channel (1909) leaves no possibility of doubt that Pinero stood squarely on the side of the social conventions of his day. Especially he approves the double standard of conduct for men and women. Even though his approval may be pragmatic rather than philosophical there can be no doubt as to its genuineness: he sees such a standard as necessary to a well ordered society. A man may be forgiven much in the way of youthful follies and wild oats, but a woman who has transgressed the unwritten social law has lost her status irrecoverably.

His heroines, then however much they appeal to us, are not the tragic victims of any unjust system but offenders against a code on which the health of society depends. The wages of sin may be social ostracism in various degrees or even death in the case of Paula Tanqueray, but whatever they are they must be paid. In certain cases, however, the full penalty may be avoided. Where there has been overt unconventional conduct but no real offense against mores, timely contrition and conformity may restore a woman to her position: in others there may be rehabilitation through the ministrations of the Church.

Pinero does not, like Ibsen, protest against the injustice of the existing social system. Instead he is a conservative, defending the existing order, a conventional moralist preaching conformity and issuing in play after play warnings against irregular conduct. He neither derives from Ibsen nor stands with Shaw but labors to keep unimpaired the social tradition.

Microfilm $3.35; Xerox $11.40. 257 pages.

MILTON'S DOCTRINE OF GOD, STUDIED IN THE LIGHT OF HISTORICAL CHRISTIANITY.

(L. C. Card No. Mic 59-4104)

Charles Louis Childers, Ph.D.
Vanderbilt University, 1959

Supervisor: Professor Claude Lee Finney

This study is an attempt to relate Milton's doctrine of God, by way of comparison, to the major historical Christian beliefs, both orthodox and heterodox. Thus, the problem is twofold: first to determine just what Milton believed about God, and second, to see just where such a view would fit into the complex pattern which is the history of Christian doctrine. In order to compare Milton's views with each aspect of the Christian doctrine of God, the term "God" is used in its Trinitarian sense.

The first chapter is introductory. First, the previous Milton scholarship, which touches on my subject, is traced briefly; then three problems, which one must face in such a study as the present one, are suggested and treated briefly. These problems are: (1) the matter of change or development in Milton's theology, (2) the question of the relation of the De Doctrina to the major poems and whether they are theologically in harmony, and (3) Milton's professed use of the Bible as the source of his theology. These problems are solved in the following ways, (1) Milton's mature theology is found in his De Doctrina and his major poems, (2) the De Doctrina and the major poems are theologically harmonious, (3) Milton did follow the Scriptures, but his use of them was conditioned by such things as his philosophical and theological preconceptions.

In Chapter II an attempt is made to construct what is referred to as a "Theological Setting" by tracing the development of the Christian doctrine of God from its antecedents in the Old Testament, in the New Testament, and in Greek philosophy, to the point where it was accepted as the authoritative doctrine of the Church. In this treatment the doctrine of God is dealt with in four divisions. They are: (1) the doctrine of God as to His being and attributes, (2) the doctrine of the Trinity, (3) Christology, and (4) the doctrine of the Holy Spirit.

In Chapters III through VI Milton's doctrine of God is discussed in these same four divisions. In Chapter III it is found that Milton's view of the being and attributes of God is in general harmony with the traditional position with one exception: since he did not believe in the Trinity, his concept of God's unity would obviously have heterodox connotations.

In Chapter IV the doctrine of the Trinity is treated and here Milton is seen to be widely at variance with the orthodox view. The Son was produced in time, was not coessential with the Father, but was used by the Father as an agent in creation and redemption. Milton felt that the very idea of a Trinity is self-contradictory. A comparison of Milton's view with those found in the major Christian anti-Trinitarian systems finds him closer to Arianism though he was not in complete agreement with any of them.

In Chapter V Milton's view of the Incarnate Christ is treated under the doctrines of the Incarnation, the Atonement, and the Mediatorial office. As to the first, Milton is found to be close to Eutychianism as to the nature of the Incarnation; otherwise he was orthodox except for Arian implications in his concept of the divine nature of

Christ. On the Atonement and Mediatorial office he was generally orthodox.

In Chapter VI is treated Milton's doctrine of the Holy Spirit, and here again Arian tendencies are noted. In this aspect of his theology Milton is very reserved, finding little information in the Scriptures and thinking it unwise to venture far into the subject without Scriptural support.

In each of the chapters, which deal directly with Milton, an attempt is made to show the relationship of the Neo-Platonic concept of emanation to Milton's doctrine of God. Particular attention is directed to Milton's Monism, which is Proclean, as opposed to the dualism of Plotinus.

The study concludes with an assertion that the foregoing investigation has demonstrated three things, (1) that where Milton was heterodox he was more in harmony with ancient heresies than modern, (2) that his doctrine of God is consistent, and (3) that every aspect of his doctrine of God demonstrates his independence as a thinker.

Microfilm $4.75; Xerox $16.20. 377 pages.

THE GUATEMALAN NOVEL: A CRITICAL BIBLIOGRAPHY.

(L. C. Card No. Mic 59-4193)

Joan Estelle Ciruti, Ph.D.
Tulane University, 1959

Chairman: Daniel Wogan

Guatemala has produced in recent years several novelists whose stature makes a specialized study on the Guatemalan novel timely. The immediate problem that presents itself, however, is the lack of adequate bibliographic sources. To alleviate this problem and to provide a basis for further work on the Guatemalan novel, the present study, in addition to a brief history of the general trends in the development of the genre, is devoted to a critical bibliography of the novels and of studies on them and on their authors. Much of the information in the bibliography has been gathered from original sources, such as literary magazines and newspapers, and from first-hand research in several libraries in Guatemala and in the United States. Each of the five hundred fifty-eight items in the bibliography is followed by a comment which attempts to summarize briefly the content of the work in question so that one may judge its usefulness.

The Guatemalan novel begins about the middle of the nineteenth century with the works of Antonio José de Irisarri and José Milla. The novels of these two authors already show characteristics that are present throughout the history of the novel: realism and romanticism, history and costumbrismo. At the end of the nineteenth century, literary influences come from outside the country and cause the novel to be oriented in two opposite directions. Under the influence of the French naturalists, Ramón A. Salazar and Enrique Martínez Sobral carry on the interest in Guatemala itself and are concerned with the problems of the country and its people. Swayed by modernism, on the other hand, Enrique Gómez Carrillo and Máximo Soto Hall write about man's search for the ideal woman and about bohemian love in Paris. Modernism is carried on in the first decades of the twentieth century in the novels of one of the country's most prominent authors: Rafael Arévalo Martínez. Since 1920, however, the emphasis has again been on Guatemala and the prevailing tendency has been regionalism. The early regionalists--such as Carlos Wyld Ospina and Flavio Herrera--show in the form of their novels some residual influence of modernism, while the later ones--such as Miguel Angel Asturias and Mario Monteforte Toledo--use modern novelistic techniques following models from France and the United States. In all of them, nevertheless, one finds the depiction of Guatemalan life and customs. Paralleling the regionalistic trend, in the 1930's there is also a revival of the historical novel in the works of J. Fernando Juárez Muñoz, Elisa Hall and others.

Most of the novels written in Guatemala have taken their inspiration from the land, its history, its people and its problems. For this reason, many of the works are of interest only to a limited audience. In the past few years, however, some of the novelists have been able to transcend this regionalistic orientation and produce works with more universal appeal. During the 1930's Flavio Herrera did it to some extent, but it has reached its culmination within the last fifteen years in the works of Miguel Angel Asturias and Mario Monteforte Toledo. These are the novelists whose fame is finally bringing attention to the Gutemalan novel from outside the country's boundaries.

Microfilm $3.45; Xerox $11.80. 268 pages.

THE JUDGMENT OF LITERATURE.

(L. C. Card No. Mic 59-3529)

Charles Carter Colwell, Ph.D.
Emory University, 1958

"The Judgment of Literature" systematically compares eight criteria of literary worth. The criteria are exemplified by brief selections from the criticism of R. P. Blackmur, Jean-Paul Sartre, Cleanth Brooks, F. R. Leavis, Lionel Trilling, T. S. Eliot, Maud Bodkin, and Norman Maclean. Their criteria locate the value of literature in: 1) its objectification of the pre-conscious impact of things, within a non-separable framework of idea; 2) its inducement of a sense of the free, creative, and temporally extending nature of the self; 3) its communication of an experience by presentation of conflicting elements, unified in tension by the affirmation of all and the denial of none; 4) its expression of a mature attitude, blended of sympathy and distanced criticism, toward the mixture of good and bad that constitutes humanity; 5) its tendency to improve socio-ethical standards; 6) its focus of a variety of experience and release of strong emotion; 7) its inducement of a distinctive psychic feeling state, including the feeling of thought; 8) its provision of a high order of pleasure. The first four are truth criteria, the fifth, and ethical criterion, and the last three, pleasure principles.

Comparison of the criteria begins at the level of practical criticism. The criteria are applied to "My True-Love" by Byron Herbert Reece, and the results compared. The crux of the comparison is the specification of the locus of pertinent fact that each criterion makes. Discussion is somewhat inconclusive, clarifying possible relationships rather than providing a synthetic evaluation of Reece's

poem. The relationships are further exemplified by brief discussion of some of the critics' own comments on Pound's Cantos.

Comparison of criteria continues, at a more theoretical level, with discussion of the relationships obtaining among criteria within one of the three groupings (true, good, pleasant). The bulk of this section argues that the three kinds of reality which the first three truth criteria specify correspond to the three phases of an actual occasion in the ontology of Alfred North Whitehead: prehension in the mode of causal efficacy, in the mode of presentational immediacy, and in the mode of anticipation.

The final chapter places the criteria within a specific theory of the order of human values, in which value is defined as those aspects of possible situations which would prompt disinterested persons to actualize them. The ontological impetus of value is the inherent demand of all value that the universe be congenial to it, and economical of it. Two intrinsic values are specified, beauty--the value of experience per se, that it is felt--and dedication--the intent to realize legitimate and possible values beyond the self. The latter is inherently the more valuable. The primary extrinsic value is truth, which either is a name of God or means a conformation with ontological stature: 1) of means to end, or 2) of appearance to reality, either a) ontological or b) phenomenal. In this system the first three critics are discussing a basic means to beauty (truth, 2a above) as is Leavis (truth, 2b above); the last three are correctly identifying the aesthetic value of literature, though not necessarily clarifying the means by which it is achieved. By means of a typology of human experience, and an argument that literature lends itself to aesthetic uses, the ethical judgment is identified as aesthetically irrelevant, although in any given case the ethical judgment may be psychologically and sometimes morally necessary.

The study's only claim to lateral inclusiveness is at the level of the criteria themselves; it is exhaustive only by virtue of vertical completeness. Its achievement is the comprehension of quite different literary criteria within a single coherent system.

Microfilm $2.20; Xerox $7.80. 167 pages.

FROM "AMOS BARTON" TO DANIEL DERONDA: STUDIES IN THE IMAGERY OF GEORGE ELIOT'S FICTION.

(L. C. Card No. Mic 59-4409)

Daniel Pierre Deneau, Ph.D.
University of Notre Dame, 1959

This dissertation was undertaken in order to arrive at some further understanding of George Eliot's technique as a novelist, specifically of her imaging technique, and of the relationship of image and theme in her fiction. The intention has been to study the nature and function of the imagery, not to count or to classify. After an opening chapter devoted to some of the special problems of studying fictional imagery, the study then proceeds to examine each narrative as an individual unit and, finally, to identify and explicate two central images in Eliot's fiction, namely, the river and the web. In the cases of Middlemarch and Daniel Deronda, the treatment of image and theme is not exhaustive, although the study determines how the imaging technique in these novels corresponds to and differs from that of the early and middle fiction.

It is concluded that throughout her career as a writer of fiction, from the Scenes of Clerical Life to Daniel Deronda, George Eliot showed a distinct interest in increasing the dimensions of her literal fictionalized world through the use of imagery. The imagery remains constant; but from story to story and novel to novel there are important differences in the quality and in the function, even at certain times in the frequency, of this imagery. For instance, the major images of "Mr. Gilfil's Love-Story," the second of the Scenes, tend simply to increase the sentimental and melodramatic tone of the story; however, the imagery of "Janet's Repentance," the third of the Scenes, shows a marked advance over that of the preceding stories and points ahead to later developments. It is true that some noteworthy advance in imaging technique is found in the late novels, but the difference is not sharp enough to set these works off in an altogether special class. Some of the most successful groups of images are those recounting "The Great Temptation" (Book VI) of Maggie Tulliver, the "history" amd "metamorphosis" of the weaver of Raveloe, the rebirth and conversion of Romola, the sepulchral marriage of Dorothea, and the entrance of Gwendolen Harleth into a "Satanic masquerade." Far less successful are those images associated with such characters as Caterina Sarti, Dinah Morris, Tito Melema, Esther Lyon, and Mirah Cohen; revealing, too, is the fact that the Garth-Vincy plot of Middlemarch, unlike the other three plots of the novel, and the Mordecai plot of Daniel Deronda contain no images of special interest. And other than Silas Marner (to a certain extent also Adam Bede), the only "heroes" surrounded by illuminating images are those in Middlemarch. The persistently recurring images of the river and the web are used in a versatile way to speak about multiple aspects of life. Moreover, especially in the early fiction, Eliot uses a set of recurring images to speak about the relationship of her heroes and heroines to the "hard"reality of life; and many images are related, especially in the cases of Maggie Tulliver, Romola, Esther Lyon, and Gwendolen Harleth, to George Eliot's preoccupying concern for religion.

A particularly interesting technique is George Eliot's apparently very conscious use of modified images—images which recount a developing sub-surface story. Not only does she sometimes speak to her readers through carefully wrought, meaningful images, but, as her modified images particularly illustrate, she clearly expected her readers to be sensitive to her method of communication. To observe, therefore, the figurative content of her novels is to observe something through which she importantly tried to shape and to communicate her vision.

Microfilm $3.80; Xerox $12.80. 293 pages.

SIR JOHN HARINGTON'S A NEW DISCOURSE OF A STALE SUBJECT, CALLED THE METAMORPHOSIS OF AJAX: A CRITICAL, ANNOTATED EDITION

(L. C. Card No. Mic 59-3096)

Elizabeth Story Donno, Ph.D.
Columbia University, 1959

This is a study of Sir John Harington's popular prose satire, The Metamorphosis of Ajax. Consisting of three parts, A New Discourse of a Stale Subject, Called the Metamorphosis of Ajax, The Anatomie of the Metamorphosed Ajax by T[homas] C[ombe], and An Apologie, the work appeared in 1596 and created a quick rush of interest; but to date it has been largely, and unjustly, neglected. In part, this has resulted from its general inaccessibility. There has been no adequate modern edition to provide either a reliable text or the annotations which would enable a modern reader to grasp Harington's mingling of learned and topical matter. Moreover, critics have tended to dismiss the work as a Rabelaisian trifle, ignoring its appeal both as a witty literary exercise and a lively social document. The aim of this study then is not only to provide a reliable old-spelling text, fully annotated, but also to re-assess the scope and merit of the work.

The text has been edited according to modern critical standards and furnished with an apparatus criticus. The copytext used is that of the original edition, printed by Richard Field, for which Harington read proof, at least in part; this has been collated with a microfilm copy of the author's autograph manuscript which furnished the copy for the printer and with the second edition, also printed by Field, which gives evidence of some minor authorial revisions.

Quite clearly, the Metamorphosis of Ajax was directed not to the general public but to a courtly circle of readers who would have recognized allusions to the religious controversies, literary extravagances, current social ills, and courtly scandals which Harington glanced at, often covertly, in merry and mocking fashion. But for a modern reader many of these topical allusions must be identified. By using Harington's own annotations to three presentation copies, as well as literary and historical sources, it has been possible to make such identifications, recorded in the annotations, and hence to reconstruct the particular Elizabethan context of the work.

In addition to a discussion of the form and intent of the Metamorphosis of Ajax, the Introduction includes an examination of certain vexing problems connected with its publication: the question of the authorship of the three parts, as well as of an anonymous sequel, the Ulysses upon Ajax, published in the same year; the order of the several editions of the three parts; and the question of licensing and piracy. This examination is followed by an account of the MS and a statement of the editorial principles upon which the edition has been based.

Microfilm $8.45; Xerox $28.80. 667 pages.

THE CONTRIBUTIONS OF FORD MADDOX FORD TO TWENTIETH CENTURY NARRATIVE TECHNIQUE.

(L. C. Card No. Mic 59-4388)

Seth H. Ellis, Ph.D.
University of Southern California, 1959

Chairman: Professor Arnold

The purpose of this study was to determine Ford's purpose in writing and to identify the technical doctrines which he adopted in order to carry out his purpose. Ford's purpose was to project the disorder and disintegration of society. He wanted to probe beneath the surface, exploring the motives and emotions of a group of characters with care and sensitivity. He aimed to examine the interaction of each character with the others in such a way that the reader would experience the character's emotions.

From a study of Richardson and the French models—Diderot, Stendhal, Flaubert, and Maupassant—Ford constructed five basic doctrines of technique: (1) The Doctrine of Aloofness—the ability of the novelist to render an affair and not intrude into his narrative for comments. (2) The Doctrine of Psychological Coil—the ability of the novelist to present one human coil or psychological progression, restricting himself to impressions which carry the story along. (3) The Doctrine of Readability—the ability of the novelist to employ sentence structure, diction, and vocabulary which are as simple as possible. He must avoid startling words, too just images, and displays of cleverness. (4) The Doctrine of Inevitability—the ability of the novelist to avoid coincidence or accidents. The situations should appear unavoidable rather than contrived. The narrative should move faster and faster and more and more intensely to its inevitable climax. The increase in pace and intensity is called progression d'effet. (5) The Doctrine of Believability—the ability of the novelist to relate the tone of the narrative to the subject. Every action, every thought must be justified. Strong situations and superhuman characters must be avoided.

Each of these five doctrines, with the exception of aloofness, is applied to the analysis of one of Ford's novels. Psychological coil (point of view) is discussed in The Good Soldier, readability (language) in A Man Could Stand Up, believability (description) in Some Do Not, and inevitability (progression d'effet) in No More Parades. Time-shift, which is the movement back and forth in time presented through the awareness of the character, is analyzed in a fifth novel, The Last Post.

Ford utilized the five basic technical doctrines to create an "inductive" psychological novel, a novel in which an affair is presented gradually through the interaction of its characters. He enlarged the scope of the Tietjens' tetralogy by concerning it with war. Ford's method seems to be somewhere between that of Joyce and the nineteenth century writers he condemned. He is not the equal of Joyce, for example, in restricting his narrative to the pattern of a single, experiencing mind. Yet the depth of his topic is too great to be presented as a chronological step-by-step progression. The reader always knows what is happening in Ford's novels, despite the intense emotional study of characters and the interrelation of characters.

No twentieth century writer has dramatized the theme of disorder and disintegration of the age with more skill than Ford Madox Ford. Ulysses, Remembrance of Things

Past, or To the Lighthouse would not suffer if The Good Soldier shared the same shelf with them. The purpose of this dissertation was not to place Ford above Joyce or Proust, or Gide or Mann, in the scale of things. It was simply an attempt to place Ford alongside them as a technician. Whenever one speaks of technique in modern fiction, Ford should not be overlooked. His experiments with the psychological novel have earned him a place in twentieth century literature. The five novels discussed in this study are proof enough. Few writers can claim so many.

Microfilm $3.15; Xerox $10.80. 242 pages.

HOFMANNSTHAL'S KLEINE DRAMEN AS SEEN IN THE FOCUS OF MAETERLINCKS "STATIC DRAMA."

(L. C. Card No. Mic 59-4310)

Calvin Holroyd Evans, Ph.D.
University of Oregon, 1959

Adviser: Maurice A. Lecuyer

No doubt exists as to the poetic kinship between Hofmannsthal and Maeterlinck, especially during the decade 1890-1900 when they were both composing works for the symbolist stage. The following points support this thesis:

Hofmannsthal was mystic in temperament and much drawn to the French symbolist poets (Verlaine, Mallarmé, and Rimbaud). He was predisposed to be favorably impressed by the first presentation of Maeterlinck's plays in Vienna. Not long thereafter he undertook the translation of Les Aveugles and wrote two symbolist plays of his own, Der Tod des Tizian and Der Tor und der Tod. Indeed, he felt himself a kindred soul of Maeterlinck's to the extent that he expressly sought out the Belgian poet during his visit to Paris in 1900.

It is apparent from the essays, correspondence, and critical writings of the two poets that their intellectual and esthetic formation was derived from common sources. Both admire the ideas of Boehme, Ruysbroeck, Novalis, and Amiel from which they develop their special dream-like mood suggestive of deeper subconscious meanings. Both regard Ibsen as the first dramatist to make his dialogue resemble that of a dream.

One detects a more palpable Maeterlinckian influence upon Hofmannsthal in the Belgian poet's essays on the feminine and on his theory of "le tragique quotidien." In the later Kleine Dramen, beginning with Der Weisse Fächer, Hofmannsthal, like Maeterlinck, poeticizes the commonplace and extracts from it a cosmic significance. In womankind Hofmannsthal, also like Maeterlinck, finds an acute sensitivity to exterior phenomena. His women frequently have a mystic's vision that perceives the underlying unity of generations and of all phenomena.

Many similarities are apparent in the mood and imagery of Maeterlinck's first literary endeavors (Le Massacre des Innocents and Serres Chaudes) and Hofmannsthal's early prose, letters and Gedichte. In the latter one finds reflected the early Maeterlinckian despair and ennui before phenomena. The tenuous character of outer nature is expressed through the same imagery: moonlight, nocturnal silence, empty streets, roses, lugubrious vegetation, all suggesting harmonies in nature which elude the poet's vision.

The essential kinship of the Kleine Dramen to "Static Drama" resides in the situation of both theaters within the subconscious. Hofmannsthal's dramatic technique resembles Maeterlinck's in his creation of a nondescript, crepuscular atmosphere (an indication of the obscure nature of the subconscious) in which his characters, though more rational and sophisticated than Maeterlinck's, struggle to feel their way back to that elemental unity of nature which they sometimes sense but never fully grasp.

The personages of Maeterlinck and Hofmannsthal refuse to accept appearances, finding even in every-day reality hidden meanings which point to their souls' affinity to a higher reality. They prefer darkness to light and seek refuge from the pain and ennui of conscious life. In short they have a fundamental death-wish. The ultimate conflict of the Kleine Dramen, as in "Static Drama," is between life and death. It is the triumph over the former which removes all vestiges of refined consciousness and effects the unity of ego and cosmos. Hofmannsthal, like Maeterlinck, used this conflict advantageously in developing a tense atmosphere.

In creating the special dream landscape that frames the movements of their characters, Hofmannsthal and Maeterlinck rely mainly upon rhythmic and tonal effects. Sometimes both men use a truncated and alliterative type of phrasing to convey the idea of a restless, ethereal humanity lost in a world of crude sensations. The actor's subtle intonation dramatizes the soul's yearnings. The images are drawn primarily from nocturnal phenomena: moonlight, falling stars, a dark sea, and the like. All express subtle nuances of nature implying the interrelationship of soul and cosmos.

Finally, Hofmannsthal did not abandon the mystic mood of his symbolist theater in his future evolution as a dramatist. In Der Turm, one finds transferred to a national, social, and political level the youthful mystic concepts. This time, not the individual, but the entire nation strives to effect a mystic union between itself and its higher destiny. Sigismund represents the underlying spiritual consciousness of a nation which perceives that entity through man's petty political, economic, and social struggles. He also uses the same dramatic devices and images that both Maeterlinck and Hofmannsthal employed earlier.

Ample evidence shows that the obvious resemblances in content and form of the Kleine Dramen to "Static Drama" may be ascribed to other than coincidence. Any study of the Kleine Dramen without consideration given Maeterlinck's role in the development of Hofmannsthal's early theater would be, necessarily, incomplete.

Microfilm $3.45; Xerox $11.80. 268 pages.

THE THEME OF DEATH IN THE POETRY OF EMILY DICKINSON.

(L. C. Card No. Mic 59-4717)

Thomas Wellborn Ford, Ph.D.
The University of Texas, 1959

Supervisor: Professor Philip Graham

Although critics have noted the great emphasis which Emily Dickinson places upon death, no one has made a study exclusively of this theme in her poetry. Death is a dominant and recurrent subject, occurring in her earliest poetry and receiving increased attention as the years pass. Death, with varying degrees of emphasis, appears in perhaps as many as half of her 1775 poems.

This study attempts (1) to determine the cause for her intense interest in death, (2) to show what her basic attitude toward death was, (3) to present those biographical factors which were highly influential in forming her attitude, (4) to analyze her major poems on death under the categories of (a) death and immortality, (b) physical aspects of death, (c) personifications of death, (d) elegiac poetry, and (5) to draw some conclusion concerning the function and significance of death in her poetry.

Death not only was a major theme in Emily Dickinson's poetry, but was largely responsible for originally turning her efforts to the writing of poetry. Her letters support the view that she was fully aware of death as a motivating force in her creations.

The underlying factor in her deep concern with death was religious. The Amherst in which she lived was still firmly attached to its Puritan traditions. Her father, Edward Dickinson, created an atmosphere of stern Christian thinking, emphasizing the importance of devotion to duty and rectitude. The pressure to experience conversion she felt from all sides, particularly from her year at Mount Holyoke, and her inability to undergo this experience resulted in doubt and anxiety over "salvation."

Exposure to Transcendentalism momentarily offered her hope for a release from religious insecurities. She could accept fully neither Transcendentalism nor Puritan thought, and her close observation of deaths and burials supported neither view.

With the Civil War, death became a very real presence, and her creative energies were roused to their fullest. Her poetry was a release from the tensions and anxieties over death generated by religious doubts, and also served as a substitute for religion.

An examination of her major poems on death reveals that her contribution does not lie in originality of idea or philosophic thought, but in the blending of idea and image. She used poetry as a testing ground for her views on death, approaching death from varied angles, and did not intend to present a consistent, ordered body of thought.

Emily Dickinson's attitude toward her subject matter influenced her technique. The external form which she chose, meters derived from the hymn books, reflects this attitude. In one sense her poetry was a great effort to understand death, God, and immortality; a great prayer or hymn for the resolution of her doubts. Her mingling of exact rhyme and approximate rhyme reflects her view that the universe is not neatly divided into black or white, evil or good, false rhyme or true rhyme, but remains a somewhat incongruous mixture.

Her ability to unite the like with the unlike, her ability to allow words, by their connotations, to modify and exert pressure on each other is the core of her style. Her attitude toward death also exerted influence here. By uniting the complexities and contradictions of words in an ordered structure, she could more readily accept the incongruities in the universe as perhaps only apparent ones.

Microfilm $3.05; Xerox $10.60. 236 pages.

SPAIN THROUGH FRENCH EYES FROM THE EVE OF THE PENINSULAR WAR TO THE AGE OF THE REALISTS.

(L. C. Card No. Mic 59-4006)

Stanley Everts Gray, Ph.D.
Indiana University, 1959

This study attempts to describe and interpret the image of Spain elaborated by the French from the beginning to the middle of the nineteenth century. The most significant feature of the French image of Spain in this period is the prestige enjoyed by Spanish themes in the works of the French Romantics, a prestige which seems to be due less to the discovery of the romanticism latent in masterpieces of Spanish literature than to various extra-literary stimuli. The question of literary influences has therefore been left aside in favor of an extensive development of the historical and ideological background of Franco-Spanish relations.

Chapter I analyzes the writings of French travelers in Spain from the late eighteenth century to the eve of the Peninsular War, Voyages en Espagne which were used as reference books by French authors throughout the nineteenth century and which, in their evocations of an "Espagne noire" or an "Espagne pittoresque," both perpetuate the conception of the philosophes and prefigure attitudes of a later period.

Chapter II considers the history of the Peninsular War of 1808-1814 and Cahpter III, through the testimony of a number of French participants in the war, its role in the change in attitude towards Spain manifest in the Romantic period.

In Chapter IV the conception of Spain found in Preromantic French literature is discussed, with emphasis on prose fiction and consideration of transmissions from German and English literature.

Chapter V deals with the Franco-Spanish War of 1823 and the characteristic writings it prompted in France, writings which are divided roughly into two categories--social and political appraisals and études de moeurs.

Chapters VI, VII and VII take up the conceptions of Spain entertained by the French Romantics, the espagnolisme of some of these authors and its significance in their literary works.

Chapter IX presents an investigation into the role of Spanish art in the formation of the French image of Spain, beginning with an analysis of the discovery of Spanish painting in this period. The enthusiasm of the French Romantics for certain aspects of Spanish art is elucidated in a discussion of the affinities of Romanticism and the Baroque.

Chapter X indicates some of the ways in which the French image of Spain relates to that which Spain has

formed of her own national character and destiny. This reciprocal influence is studied in certain Spanish works in the costumbrista mode and in the attitudes of members of the so-called "Generation of 98."

The nature of the French Romantic image of Spain is examined in terms of the interaction of three main factors: the persistence of certain traditional attitudes towards Spain handed down from preceding ages, the political upheavals which brought Spain and France into contact in this period, and the growth of a Romantic mentality which found, to some extent, a confirmation and a realization of its ideals beyond the Pyrenees. The attraction of Spain was not merely that of the exotic; it involved an imperfectly expressed, somewhat naïve, but basically serious appreciation of the character of the nation, and as such, it had significance for the literatures of both countries.

Microfilm $6.40; Xerox $22.20. 503 pages.

A STUDY OF THE ORIGIN, CONTENT, AND LITERARY SIGNIFICANCE OF THE ÉLOGES ACADÉMIQUES OF JEAN LE ROND D'ALEMBERT.

(L. C. Card No. Mic 59-4390)

Hope Haskell Hayton, Ph.D.
University of Southern California, 1959

Chairman: Professor Knodel

Although the eulogies composed by Jean Le Rond D'Alembert (1717-1783), chiefly in his capacity as secrétaire perpétuel of the Académie Française from 1772 to 1783, have long been used as a rich source of information, they have received scant attention as a body of writing worthy of independent consideration. Detailed examination of this fairly large mass of material—over sixty eulogies—has made it possible to define the peculiar and significant place which it occupies in French letters.

As secrétaire perpétuel of the Académie des Sciences from 1699 to 1741, Fontenelle (1657-1757) was the first person to transform the academic eulogy from mere panegyric into a concise biographical and expository document which he referred to as a "historical eulogy." D'Alembert acknowledged Fontenelle as his model, but he is much more than just a competent disciple of the scientist-philosopher.

The modifications that he made in the historical eulogy were the result of both external and personal circumstances. Among the former were (1) the great variety of professions, talents, and achievements presented by the members of the Academie Française whom D'Alembert eulogized and (2) the marked change in the intellectual climate of France during the second third of the eighteenth century, when rationalism was being openly championed and intellectual battle lines were becoming more sharply drawn. Immediately personal were (1) D'Alembert's close association with the other philosophes, especially Voltaire, (2) his extreme sensitivity, and (3) a certain intellectual detachment characteristic of him as a mathematician.

Because many of his subjects were primarily literary men, D'Alembert had to make numerous literary characterizations and judgments. He did not, however, simply apply the rules laid down by Boileau, as did most critics of his time. Even though D'Alembert did not escape many neoclassical strictures, he instinctively pointed out the relationship of specific literary works to their writer's physical and psychological make-up, as well as to his family and social background. This is the first striking indication of what was to become the Sainte-Beuvian method of literary criticism.

Biography, then, already plays an important role in the predominantly "literary" eulogies; but in the éloges of some men whose achievements were not primarily literary, biography is even further developed, far beyond anything found in Fontenelle. In fact, D'Alembert lets himself be carried away by his fascination with the problem of understanding human motivations. In short, consciously or unconsciously, he is already writing biography in the modern sense.

A more obvious modification of the historical eulogy is the increased polemical character D'Alembert bestows upon it. His constant battling against the infâme and his blind partiality for Voltaire have frequently obscured the other aspects of the eulogies. These concerns, however, did contribute to the disintegration of the oral panegyrical form of the éloge, for when D'Alembert added notes—often indirectly or openly polemical—to the printed text of his eulogies, they sometimes became as important as the eulogy itself.

It is clear, therefore, that D'Alembert's éloges are not merely competent imitations of Fontenelle's vies des savants, which latter still remain within the framework of the classical panegyric. D'Alembert's éloge does still cling tenuously to the last vestiges of the panegyric, but new forces are stirring within it that are about to shatter the old formal structure. Thus, the D'Alembertian eulogy appears as a vital intermediate form in the organic continuity of French literary criticism and of biography as a literary genre.

Microfilm $4.55; Xerox $15.40. 356 pages.

"AUT PRODESSE SOLENT AUT DELECTARE": A STUDY OF FOUR NON-DRAMATIC WORKS BY THOMAS HEYWOOD.

(L. C. Card No. Mic 59-3531)

Sarah Evelyn Jackson, Ph.D.
Emory University, 1959

Thomas Heywood (1570?-1641), a contemporary of Shakespeare, is remembered by literary historians and students of the Renaissance as the author of a handful of plays. Few critics have accorded more than passing recognition to his other productions--translations, chronicles, non-dramatic prose and poetry. However, the variety and volume of these secondary works reveal Heywood as one of the most versatile and, indeed, most typical of Renaissance writers. Particularly helpful in establishing these claims are four works: Troia Britanica (1609), Gunaikeion (1624), The Hierarchie of the blessed Angells (1635), and The Life of Merlin (1641).

The main subjects are as disparate as the material found within the covers of each, but all were topics of great interest in the first half of the seventeenth century. The

first work is concerned with the legendary history of Britain, establishing the ancestry of her people in the grandson of the Trojan Aeneas. Gunaikeion, which tells of all types of women, was Heywood's contribution to the feminist controversy, a topic that has always had its appeal but that was particularly vital in the years preceding 1624. The Hierarchie manifests the concern of men with the world of spirits; and The Life of Merlin emphasizes the traditionally popular prophetic literature as well as the middle-class interest in England's history.

Not only in subject matter is Heywood versatile and typical of his age, but also in his choice of literary forms and in the handling of his material. He was content to use forms long since established in popularity--the prose of his day, the ottava rima, devotional lyrics, and emblems. He followed the lead of such men as Sir Thomas Browne and Robert Burton in his reliance on authorities and his lavish use of sources, which ranged from the legends of classic mythology to the writings of modern authors.

Frequently his choice of material seems without plan but, in actuality, he was careful to choose topics and stories that would appeal to the audience for whom he wrote--the English middle class. His works blend instruction and delight, the two qualities demanded by this group. With his love of England, his pride in her people and their accomplishments, his emphasis on the virtuous life as an aid to prosperity, he stands as a worthy spokesman for the bourgeoisie.

This emphasis is found also in his dramas, revealing a unity in the entire body of his works that has been overlooked by critics who have dismissed his non-dramatic works as of little importance. The same themes and the same interests are evident in all his productions.

One of the most interesting characteristics of his non-dramatic works is one for which he found no outlet in stage plays, that is, his love of digressions and his delight in conversing with his reader. In this material, frequently related to the main topic by the barest thread of reference, the reader finds some of the most delightful passages of his works; they form an addition, not a detraction. More important, they provide a unique view of Thomas Heywood, the man and the writer, as a human individual. They reveal him as a man intensely interested in people, with a genuine concern for giving them not only delight for their hearts but nurture for their souls.

Scholars have for too long disregarded the non-dramatic works of Heywood, but this study of four of them has proved a rewarding one for the inquirer, giving a truer and more colorful picture of Thomas Heywood, dramatist, poet, and prose writer than elsewhere encountered.

Microfilm $2.90; Xerox $10.00. 272 pages.

ALFRED DÖBLIN'S QUEST FOR SPIRITUAL ORIENTATION, WITH SPECIAL REFERENCE TO THE NOVELS DIE DREI SPRÜNGE DES WANG-LUN, BERLIN ALEXANDERPLATZ, AND BABYLONISCHE WANDRUNG.

(L. C. Card No. Mic 59-4522)

Anne Liard Jennings, Ph.D.
University of Illinois, 1959

Literary critics customarily maintain that religious motifs appear in Döblin's works only from the 1940's on. Those few critics who find evidence of religious thought in Döblin's early works (before the 1940's) tend to dismiss this as a mere stylistic device or as a concession to the literary vogues of his day. The present study shows, however, that the metaphysical and theological trends of thought which ultimately led to Döblin's conversion were present from the very beginning. The author went through a distinct phase of cynicism and atheism, but even this period of rebellion is part of a consistent development in his religious quest.

The hero of Döblin's earliest published novel, Der schwarze Vorhang, (written 1902-03, published 1919), is represented as the innocent victim of mysterious malevolent powers intent upon corrupting and destroying man. The novel Die drei Sprünge des Wang-lun (1915) is his first step toward justifying God's ways to man. In the course of this novel, the conviction grows that man is not delivered to demonic powers without mercy but is free to determine his own fate. One can commit spiritual suicide by gratifying one's voracious desire for self-assertion and sensual pleasure, or one can strive for purification by subjecting oneself willingly to self-sacrifice and suffering. Through his outrage at the injustice in the world, Wang-lun is suddenly transformed from a criminal to a Christ-like savior figure transcending personal identity. At this stage it is thought possible to achieve near-divine merit through unselfish concern with the affairs of man and the world.

In his next major novel, Berlin Alexanderplatz (1929), Döblin takes great strides toward faith in an orderly world governed by a benevolent power. In so doing he completely revaluates his concept of self-sacrifice. He still shows the world to be of a distinctly dualistic structure comprising the carnal world of temptation and sin and a superimposed spiritual world of purification and salvation. Through untiring self-sacrifice and humility one can at length become worthy of God's grace and be transformed into a spiritual being. The evil in the world is thus subordinated to an all-wise plan and purpose. The function of evil is to warn man, in his blindness, to surrender in humility and faith to the divine entity which exceeds his comprehension.

In spite of its comic elements, the novel Babylonische Wandrung (1934) is the summit of Döblin's spiritual quest. In this work, conceited self-reliance is construed as criminal. Man must be subjected to extreme misfortune and suffering in order to be cured of his haughtiness. An unnamed benevolent regulator maintains a close watch over man in the labyrinth of life. Evil seems to be all-powerful in the world; but, in reality, demonic powers are only a part of God's system of messengers and guardians. Providence remains passively behind scenes; but with his daily practice of vigilance and humility, man can suppress demonic and chaotic forces and uphold the supremacy of spiritual powers.

Döblin demonstrates his desire to explain and justify the existence of evil in the world by introducing a devil figure in each of the three novels following Der schwarze Vorhang. In all three novels a complacently happy and self-satisfied existence is felt to be a threat to the spiritual self. Suffering is glorified as the precious means of regenerating selfless and humane sentiments. Purging one's ego of self-indulgent desires and yielding to the spirit of self-sacrifice is viewed as a means of deliverance and salvation.

Döblin's road was not an easy one. The outbreak of demonic traits even in the heroes of his later works shows that his religious quest never ceased to be plagued by doubts and mental anguish.

Microfilm $3.40; Xerox $11.60. 263 pages.

GOETHE AND CHARLOTTE VON STEIN IN TWENTIETH-CENTURY GERMAN FICTION.

(L. C. Card No. Mic 59-4932)

Kathryn Ann Johnson, Ph.D.
University of Michigan, 1959

Goethe's relation to Frau von Stein, with all its profound and multifaceted implications, has engaged the critical attention of scholars--and the curiosity of others--ever since his letters to her were first published in 1848. The rise of the biographical novel as a new literary genre since the turn of the century was bound to attract a variety of fiction-writers to the same intriguing problem, the reflection of which may well be considered as one segment of the contemporary "Goethebild." The aim of this study is to investigate and to evaluate the nature and quality of this reflection by a comparative analysis of the treatment of the subject matter and of style. Ten works are included: Burg, Alles um Liebe; Trentini, Goethe; Kolbenheyer, Karlsbader Novelle; Janetschek, Frau von Stein; Servaes, Jahr der Wandlung; Lux, Goethe Bäumer, Eine Woche im Mai; Schwabe, Wandlung des Herzens; Kay, Meine Schwester oder meine Frau; and Fink-Töbich, Einer Einzigen gehören.

Certain aspects of biographical fiction as such, which must also affect any critical approach to the problem at hand, are first taken up. This discussion is necessitated by the comparative paucity of pertinent antecedent research in the principles involved in the relation of the genre to pure biography on the one hand, and to pure fiction on the other. The origins of biographical fiction in modern psychology and some contributory factors leading to its present form are likewise considered in this connection.

The framework for any narrative of this type is of necessity to be found in the established biography of the protagonist. Hence a brief review of some facts and features of Goethe's life, as interpreted by scholars, is next presented. This will furnish a guide in assessing the historical veracity of the works in so far as this might prove fruitful for a better understanding of their authors' artistic aims.

The narratives themselves are then analyzed individually, but divided into two groups, according to scope and perspective, which may be either partial or total. The emphasis here is placed on the stylistic techniques employed by each author in order to arrive at his own particular interpretation of the characters and incidents involved.

A final comparison of all the narratives, in terms of what fiction devoted to Goethe and Frau von Stein, is, and what it might be expected to be, leads to a number of observations. While the novels under discussion should certainly meet aesthetic standards when regarded purely as fiction, there is an inescapable biographical obligation spelled "Goethe," which carries its own symbolic reward. Whether it be Goethe the man or the artist, the poet or the thinker, these two aspects of the author's task must be completely fused. Only two narratives are presented from Charlotte's point of view; the others all center on the figure of Goethe seen in whatever light. The interpretations range from the liberation of the artist and the man to the love of a great woman for the poet. But while a variety of stylistic and other experiments have resulted from an attempt to escape the limitations of the genre itself, in a broader perspective the conclusion may be warranted that the truly basic problem, i.e., the role played by destiny in this historical encounter, seems to have been overlooked or ignored, if recognized. Thus, the quality of the "inevitable" is lacking throughout, the level of the symbol never achieved.

Nonetheless, at least three of the narratives (Kolbenheyer, Bäumer, Fink-Töbich) appear to provide a reasonable indication that the genre of biographical fiction, without serious injury to the ambivalence of its purpose and appeal, may yet approximate our present-day standards of novelistic art.

Microfilm $3.15; Xerox $10.80. 241 pages.

LITERARY FIGURES IN FRENCH DRAMA (1784-1834)

(L. C. Card No. Mic 59-4935)

Oldrich Hynek Kadlec, Ph.D.
University of Michigan, 1959

A significant facet of French drama in the period from 1784 to 1834 were plays in which literary figures appeared as principal characters. Such plays were of two distinct types: those which depicted an imagined life of literary celebrities in the legendary Elysian Fields and those whose plots were based on various episodes from the lives of literary figures in their own period. This study is concerned with the role of literary figures in the second and larger category of plays, referred to as episodic dramatizations.

An effort has been made to bring together in one compilation the names of all the French literati who up to the year 1834 appeared in episodic dramatizations, the titles and the authors of these plays, as well as the dates and the theaters of their first performances. The episodic dramatizations chosen to be discussed present a concise but representative view of the treatment given to literary characters in general and to Beaumarchais, Boileau, Corneille, Descartes, Diderot, Fénelon, Fontenelle, La Fontaine, Le Sage, Malherbe, Molière, Racine, J.-B. Rousseau, J.-J. Rousseau, Saint-Evremond, Scarron, Mademoiselle de Scudéry, Madame de Sévigné, and Voltaire, in particular.

To demonstrate how the authors of these dramatizations portrayed the literary figures of their choice, plot summaries and excerpts from the dialogues are used. Whenever available, comments and reviews of the plays by contemporary critics are quoted or paraphrased. At the end of each chapter the presentation of the character of the literary figures in the selected plays is reviewed and evaluated in the light of present-day criteria, and the objectives of the playwrights are appraised.

The desire to propagate the idea of bienfaisance seems to be one of the main objectives for which literary figures were chosen to appear as characters in episodic dramatizations. This particular desire on the part of the playwrights explains why certain minor figures in whose biographies can be found a number of benevolent actions were chosen more frequently than some of the major figures whose lives offered few or no examples of altruism. The episodic dramatizations were evidently one of several literary forms in which the aspiration to instill moral lessons was expressed and may be viewed, by and large, as fitting into the long tradition of French moralistic drama.

At the same time these dramatizations are interesting as social documents reflecting the interest which the society of the time felt in the biographies of French literary figures and in their ideas. They show how these figures, in their daily lives, followed the principles which they expounded in their works. Occasionally they offer curious sidelights upon the personal habits and weaknesses of the literary characters or contain the kind of literary gossip of which the period was so fond. By and large, however, most of the 122 literary figures who appeared as characters in episodic dramatizations during the period 1784-1834 were presented in a favorable light.

Microfilm $2.90; Xerox $10.00. 224 pages.

THEME AND MEANING IN THE POETRY OF H. D.

(L. C. Card No. Mic 59-4013)

J. Lee Kaufman, Ph.D.
Indiana University, 1959

The poetry of H. D., born Hilda Doolittle in 1886, was first presented to the reading public in Volume I of Poetry as a demonstration of Ezra Pound's school of Imagisme. Since then it has been customary to think of H. D. as Imagistic, although in truth neither she nor any poet could long adhere to a doctrine that restricted poetry to brief metaphors in free verse. It is more to the point and less limiting to say that she is a minor contemporary poet, who, beginning with Imagism, continued with its characteristic free verse and clear images but soon departed from its brevity and lack of comment.

The central interest in this dissertation is the themes and meanings of the poems. To this end I have examined Collected Poems, containing the early most Imagistic poetry, as a unit, analyzing the predominant themes and pointing out the images that make up her "world." The succeeding chapters indicate the development of her themes through analyses of individual poems and her two dramas.

The chief themes of her early work are love, beauty, art, and a relationship with the god. Her favorite form is a short lyric presented dramatically in the person of a mythological woman. A frequent motif is the loss of a loved one through infidelity or death. Often she writes of the dilemma of a woman who has unsuccessfully tried to combine art and love. Especially noticeable in the early work is the preponderance of Greek places, characters, and artifacts.

The themes and motifs continue in her later poetry with some changes. The poems become more personal and less dramatic, and her temporal and geographical range extends from 300 B. C. in classical Greece to 1946 in London and includes Egypt and Europe as well. The interest in art and beauty decreases as the interest in love and the god-relationship increases and shifts until Love becomes a medium for the mystically realized contact with the infinite power who animates the religious of which Jesus is the culmination. While this theme progresses, she also retains an interest in erotic love and the problems of a woman whose lover has proven inadequate to her high ideals of love and art.

Generally speaking, her poetry is at its best when it expresses in images of antiquity the pain and hurt that come to a sensitive nature with exposure to love, beauty, and the mysteries. Her poetry is at its poorest when it attempts the didactic, comes close to the contemporary scene, or tries to present a rational view of her philosophy. Hers is a lyricism of emotion seen from a distance, expressed in fresh, clear images. Limited in range she definitely is and, therefore, minor; but she is one of the few excellent minor lyricists.

Microfilm $5.05; Xerox $16.80. 394 pages.

THE MORAL THEMES OF E. M. FORSTER

(L. C. Card No. Mic 59-4861)

Lawrence Lynn Lee, Ph.D.
University of Utah, 1959

Chairman: Jack Garlington

The evidence of the fiction suggests that E. M. Forster has two major themes embodying essential values that he never gives up: first, that one should be an individual and not simply a social being; and, second, that men must love one another if they are to be men. However, Forster finally believes it difficult, if not impossible, to make the values these themes embody function in the actual world.

But a third such theme, grounded in belief in the power of the earth to save man, while exceedingly important in almost all the early works, is the one theme that Forster will later almost completely give up. He does not lose his love for the earth; he loses his faith in its efficacy to save.

Forster's themes can probably be most clearly seen through an examination of his characters and his plots. There are, at least in the early works, three general classes of characters that Forster seems to hold up as representing a kind of moral value. In this dissertation, they have been called the man of action, the man of mind, and the man of the earth. Forster's ideal man would seem to be one who can join together action, mind, and a strong feeling for the earth.

The man of action is most involved with this actual world. He is usually a moral man; but too often his idea

of correct action is limited and narrow--and this narrowness can make him evil. The man of mind is concerned with finding out the truth of things. He, because he searches for truth, is usually higher on Forster's scale of value than the man of action--but he can be sterile. The most valuable of all is the man of the earth; he is almost the noble savage, in fruitful contact with the teeming life of the earth.

As for the plots, one must note that the meaning of the plots is to be found in the whole, and that the characters are, of course, integrally related to the plots. All of Forster's plots seem to be dialectical: that is, they are the working out of problems, social, individual, moral, through a kind of conflict of ideas and characters.

Using, then, character and plot, one can trace Forster's values, changing and stable, through the fiction in chronological order. In the short stories and the early novels, Forster's values are clearly expressed: the earth is good; it can confer salvation almost as a kind of grace; man loses contact with the earth by too much social awareness; he must return to the earth if he is to achieve individuality or love.

Gradually, however, Forster develops the theme that grace is not given by the earth but must be earned. This theme informs A Room with a View and Howards End. In addition, he widens his view of the social world--and finds it more complex than the world of the early novels.

With A Passage to India, Forster has completely surrendered his faith in the power of the earth to save; even his faith in individualism weakens. And love, which should take the place of the earth, seems to fail. Passage is the most pessimistic of his books; he reasserts all his old values, but recognizes them as values only, not as forces that can solve problems. For the first time, Forster looks at the whole universe and finds that universe immense and incomprehensible. Man is no longer the center. But his book is not a rejection of life: its greatest difference from the previous ones is that it does not arrive at a final reconciliation of troubles. Human values exist; so does the great universe; one must accept the universe even as he holds on to his values.

Microfilm $3.60; Xerox $12.20. 280 pages.

THE NOVELS OF WALTER DE LA MARE.

(L. C. Card No. Mic 59-4644)

Doris Ross McCrosson, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. E. C. Bolles

The five novels of Walter de la Mare are discussed in this dissertation in an attempt to arrive at a coherent statement of their meaning. Evidence is given to show that the first novel, Henry Brocken, (1904) is more than just the story of a bookish child given to dreaming; that The Three Mulla-Mulgars (1910) does not merely concern itself with the adventures of three monkeys; and that The Return (1910) is not a domestic melodrama with a Jekyll-Hyde twist. Evidence is also presented to show that de la Mare's acknowledged masterpiece, Memoirs of a Midget (1921) is not an ingenious commentary upon the plight of the individual in society; and that At First Sight (1928), although hardly more than a long short story, is not merely a boy-meets-girl, boy-loses-girl tragedy, but rather the final statement of the particular vision of life developed by de la Mare in his novels.

Believing that the only reality is that which is apprehended by the imagination, Walter de la Mare tested his concept of the supremacy of the imagination in four different ways, for At First Sight is fundamentally a continuation of the theme of The Return. Henry Brocken explores the validity of the creative imagination, while The Three Mulla-Mulgars is a parable of the quest for the inexpressible in which the imagination is everlastingly engaged. In The Return love is discovered to be an aspect of the imagination for through its power reality is found, however briefly. The central character of Memoirs of a Midget achieves knowledge of the ultimate reality with indifferent success because she is unable to communicate: She knows her Self but she cannot know others. In At First Sight love again proves to be the ultimate imaginative experience, but as in The Return, the union of two imaginations is momentary.

The novels of Walter de la Mare thus point to the conclusion that although "the inmost self of each of us is a livelong recluse," man can truly experience reality, albeit briefly, through the power of his imagination.

It may be that this conclusion is one of the reasons that de la Mare abandoned the novel form which requires the ability to structure and present a sustained and developing vision. It is also possible that this conclusion explains his failure as a novelist. He was able only to perceive the mystery and wonder of life; he was unable to develop his belief in the imagination into a metaphysical concept, or a sustained faith. Thus he failed to achieve a truly meaningful vision of life.

Microfilm $2.00; Xerox $6.80. 143 pages.

DIE GEISTIGE ENTWICKLUNG PAUL ERNSTS IN SEINEN THEORETISCHEN SCHRIFTEN VON DEN ANFÄNGEN BIS 1918. [GERMAN TEXT].

(L. C. Card No. Mic 59-4024)

Gerhard F. Megow, Ph.D.
Indiana University, 1959

While the voluminous theoretical work of Paul Ernst (1866-1933) hitherto was predominantly exploited for critical evaluation of his poetic production, this dissertation undertakes to appreciate the theoretical writings on their own merit. Ernst's approximately 450 essays and longer tracts, collected more or less at random in a dozen volumes, were studied in chronological order with the aim of sketching a gradually unfolding pattern of the poet's ideological development. The study for the first time devotes particular attention to two volumes of essays, Völker und Zeiten im Spiegel ihrer Dichtung, edited and published by Karl August Kutzbach in 1940 and 1942. The dissertation confines its investigations to the period from the beginnings of the theoretical writings until 1918, when Ernst reached a terminal stage in his development. However, some basic concepts of the essays published after 1918 are also briefly discussed.

The body of the dissertation consists of the following chapters:

Chapter I: "Bildung und Auflösung erster Ideale in der Jugend, den Studienjahren und der Sozialistenzeit (1866-1896)." The basic attitudes reflected in Ernst's earliest theoretical writings are shaped by impressions received in the parental home and by the conservative traditions of his rural home town.

Chapter II: "Loslösung von den gesellschaftsorientierten Ideologian und Rückzug auf die eigene Person (1897-1903)." Rejecting contemporary society as morally bankrupt and self-destructive, Ernst turns to creative writing and extolls as the poet's foremost task the preservation of universally valid ethical standards even though this may mean renunciation of public acclaim in personal isolation.

Chapter III: "Der Weg zum Ideal einer persönlichen Sittlichkeit (1904-1910)." Ernst's creative work in the drama causes him to abandon the belief that universally valid ethics exist. Instead he postulates an individualistic morality dictated by the moral will of the individual.

Chapter IV: "Von der persönlichen Sittlichkeit zur Religion (1910-1918)." Proceeding from the proud moral will of the individual, Ernst finds by measn of a reinterpretation of Christian concepts deliverance from his personal isolation as well as a binding force for a homogeneous society.

Chapter V: "Die Grundzüge der geistigen Entwicklung Ernsts." A summary of the basic characteristics of Ernst's ideological development till 1918 is followed by a short discussion of the ensuing period. Although theoretically solved by 1918, certain inherent tensions continue to manifest themselves in the essays written in Ernst's later years.

The study shows that Ernst alternated periodically between two basic drives of his poetic nature, which he himself did not fully recognize: the tendency to engage in purely personal speculative thought and the desire to exert directly an ennobling influence upon society. In the years 1916-1918 he finally resolved the conflict by conscious acceptance of the dichotomy.

It is furthermore established that the chronological development of Ernst's theories is of much greater significance for the interpretation of his creative work than has hitherto been assumed.

Microfilm $3.55; Xerox $12.00. 275 pages.

A STUDY OF KEATS'S ENDYMION.

(L. C. Card No. Mic 59-4961)

Bruce Edward Miller, Ph.D.
University of Michigan, 1959

The purposes of this thesis are to elucidate the meaning of Endymion, to examine its artistic means, and to estimate its literary value.

The first chapter is a study of the scholarship on the poem. In it I summarize the views of previous students and try to criticize these views in the light of the methods by which they have been supported. The writers whose work I find most useful are Lucien Wolff, Robert Bridges, Ernest de Selincourt, Clarence D. Thorpe, and John Middleton Murry. In this chapter I try to show that there are faults in the reasoning of those critics who consider Endymion to be primarily an expression of erotic love.

The second chapter is a description of the mode, an analysis of the way in which the poem communicates meaning. Within the basic narrative structure I find four different kinds of writing: description, didactic commentary, odic verse, and what I call significant image. Significant images I define as those (the "crown of life" I, 800-813 , the image of the moon III, 103-187 , and the Cave of Quietude IV, 512-562) which, in various ways, become symbolic of ulterior meaning. The poem as a whole, I suggest, acquires meaning through its working to elucidate the ideas implied in these key images.

The third and fourth chapters are a study of the meaning, which I take to be primarily concerned with love in its various gradations as a means by which man comes fully to know ultimate reality and thus to be perfectly happy. Endymion's long speech to Peona at the end of Book I (669-989) is the statement, I believe, of a scale of values. In the first part of the speech Endymion says that happiness is a unification of the self with the ultimate reality which creates and sustains all other reality. And then he describes successive steps by which man progressively finds more complete union with that reality. The steps are intense contemplation of nature, enjoyment of myths and legends, friendship, and love. In the second book Endymion tries to find happiness in a union with ultimate reality through love. He fails, however, for his attitude toward his beloved is selfish. She is means rathern than end; he cares more for his own good than for hers. The experience of the third book is a corrective of Endymion's self-centeredness. He learns to be concerned with others for their own sake, not his. In the fourth book Endymion, his attitude to love now rectified, is torn between two kinds of affection, which he believes are mutually exclusive. He tries to decide between the Indian Maid, who would give him human, natural love at its best, and Cynthia, who requires spiritual adoration. He thinks first that Cynthia is too far above him and that he will love the Indian Maid. But when the Maid tells him that they cannot live together, he abjures further communication with the natural world and determines to dedicate himself to solitary meditation upon spiritual truths. After he has made this ultimate renunciation of the pursuit of his own good, he receives his reward. The Indian Maid, symbol of temporal reality, is transformed before his eyes into Cynthia, the figure of ultimate, all-sustaining reality, and he achieves his goal of union and happiness.

The fifth chapter is a description of the form, the narrative structure, the versification, and the diction. Here I try to show what was Keats's artistic aim and how he fulfilled it.

The sixth chapter is an evaluation. Although I find the criticisms which are often made of the unity of the poem to have some truth, I suggest that Endymion is not really incoherent. It appears to have a basic structure, even though Keats obscures that structure by excessive stylistic ornament and occasional narrative digression. I believe that the poem is valuable as a commentary upon intimately personal emotions and attitudes which elude scientific or philosophical description.

Microfilm $2.40; Xerox $8.40. 183 pages.

CRITICISM OF THE ZEITGEIST IN PRE-NATURALISTIC GERMAN LITERATURE, 1860-1880.

(L. C. Card No. Mic 59-4548)

Harry Walter Paulin, Ph.D.
University of Illinois, 1959

Most experts are of the opinion that the literature of the Gründerzeit, the period of Germany's establishment as an empire in 1870/1871, was of a generally mediocre quality. They also feel that the writers of this time were too fascinated by internal events and by the pervasive materialism of the age to censure the abundant wrongs of contemporary society.

This study analyzes the works of Wilhelm Raabe, Theodor Fontane, Marie von Ebner-Eschenbach, Ferdinand von Saar, Ludwig Anzengruber, Gustav Freytag, Friedrich Spielhagen, and Eugenie Marlitt during the years 1860-1880. Not only are these writers studied for purposes of determining whether they expressed genuine disapproval of various aspects of their time, but also to ascertain how effective their criticism was.

The results of this investigation prove that the writers in question were critically attuned to various conditions of their time. There was, for example, denunciation, especially by Wilhelm Raabe, of the shallowness and artificiality which prevailed in the German way of life before and after 1870. Living during the time of the Kulturkampf, i.e., during the struggle between political Catholicism and the Prussian state, the writers sharply censured Catholic policies and at the same time aimed an attack at strict orthodoxy whether it was Catholic or Protestant. The period was one of educational reforms, of women's rights, of rising industrialism and the growth of the proletariat. The traditional role of the family as the fundamental unit of stability in society was endangered by the loss of parental authority and sense of responsibility. There was an inevitable rapprochement between the middle class and the aristocracy due to the fact that the prestige of the latter was declining and that of the middle class was ascending. The period of 1860-1880 was also one of anti-Semitism. All of these factors entered, in varying degrees, into the literary presentation of the time.

Compared with the naturalists a generation later, the writers of the sixties and seventies generally lacked directness in their approach to the social, political and economic problems of their time. Yet, they must be given credit for their awareness of existing problems. Wilhelm Raabe, especially, denounced the new materialistic spirit that came over Germany during 1860 to 1880. And although his contempt was couched in symbols, his symbolism has the suggestive power of satire. Although his writings represent a passive turning away on the author's part, this retreat describes more poignantly than an aggressive stand would the spiritually crushing force of the new period. Friedrich Nietzsche was akin to Raabe in many ways with regard to his concern over the shallowness and superficiality of German culture. Theodor Fontane in the sixties and seventies as yet gave little evidence of a Zeitkritik, although his later novels penetrate with insight the society of the seventies. Marie von Ebner-Eschenbach and Ferdinand von Saar presented keen, though not abundant, reflections on their time. Ludwig Anzengruber was straightforward in his condemnations, although he might have been even more effective as a critic had he shifted his focus more from the Austrian peasantry to the ills of city life. Finally, although Freytag, Spielhagen, and E. Marlitt wrote primarily to suit popular taste, their works do contain criticism and, therefore, deserve our attention here.

Microfilm $2.80; Xerox $9.60. 214 pages.

AN INTERPRETATION OF LEANDRO FERNANDEZ de MORATIN – THE MAN.

(L. C. Card No. Mic 59-4465)

Patricia Coughenour Redick, Ph.D.
University of Pittsburgh, 1959

The general derogatory attitude on the part of the critics regarding the character and personality of the acknowledged outstanding playwright of the eighteenth century prompted this study of his letters, travel notes, diary, and autobiography in order to learn at first hand more about this man. These sources are organized so as to present directly those comments of Moratín which may indicate his attitudes toward the main sources of man's experiences: the material world of places and things; people; the realm of ideas; and the awareness of one's own self.

In the attempt to present an organized pattern of the personal characteristics of Moratín it was important to note his reactions when faced with the actualities of the world. By noting what kinds of things he thought important to write about, what qualities or aspects of things he noted, what things he liked or disliked, what aspects of a country and a people pleased him, amused him, or shocked him, we may gain another means of insight into his personality. In the interpretation of a man it is necessary to note not only his theory, or "preaching", but also his practice. Thus this study records Moratín's observations of different nations and nationalities, their daily life, cultural achievements, forms of government, religious practices, manners and morals, means of transportation and communication, dress, and social institutions.

His comments concerning his family, friends, superiors, critics, and enemies are noted to learn of his attitudes toward, and capacities for various personal relationships, and the significance of people to his life. Those statements whereby Moratín presents his theories concerning government, religion, aesthetics, ethics, and society are a valuable part of this study in determining how consistent were his beliefs and actions. This chapter discusses in detail Moratín's basic values of verisimilitude and simplicity which he applied in judging the excellence of any artistic expression; drama, poetry, opera, music, painting, sculpture, and architecture. This same chapter presents Moratín's comments regarding choice of appropriate artistic subject matter, both from a consideration of the artist's moral responsibility to society, as well as from the temperament of the individual artist. In the section on ethics Moratín's stoicism is fully detailed. His theories on government parallel those of the eighteenth-century intellectuals who believed in reform, but accepted the principle of authority in government. Another chapter deals with those statements which Moratín makes about himself, his analysis of his virtues and his weaknesses, his opinions on his literary productions, his evaluation of the successes and failures in his life.

The nature of the source material presents at times an excellent opportunity for a correlation of Moratín's personal traits on many levels. For example, he will mention the same event in his travel notes, in a letter to a friend, and in a note in his diary, maintaining always the same attitude. Moratín's most striking characteristic is his incorruptibility. He was a gentle, fastidious, conscientious, retiring man, but he had the true dignity of the sincere. His genius was intuitive and not intelligential, for all his exertion of observation, method, and discipline. The most exciting and original qualities of Moratín's mind would be missed if he were to be considered solely as a typical neoclassicist. Moratín had the intuitive gift of recognizing an essential, pre-rational, human principle in a situation. He possessed a natural instinct and awareness of the universal concept that underlies all drama — conflict. The other remarkable characteristic of Moratín's mind may be called a comic grace. He had that quick sensitivity that remembers one idea while it entertains another, that transformation of mood that is not possible to a sober, systematic spirit. Above all Moratín had that paradoxical combination of detachment and sympathy which makes for the comedian. While his stated aesthetic values follow the humanistic tradition of the Enlightenment, he supported these literary precepts as they facilitated his belief that realism was the greatest artistic goal.

This study includes a biographical sketch of Moratín, as well as a chapter dealing with the political, religious, and aesthetic values of the intellectual in the latter half of the eighteenth century in Spain with emphasis on the differences between the two leading literary groups in relation to French influence. There is also a chapter which outlines the evaluation of Moratín's character and personality by ten well-known Spanish, French, Italian, and German literary critics, plus some comments on Moratín as a person by his contemporaries.

Microfilm $2.35; Xerox $8.20. 178 pages.

NAME-CHARACTERIZATION IN THE WORKS OF THOMAS MANN.

(L. C. Card No. Mic 59-4738)

Walter Langridge Robinson, Ph.D.
The University of Texas, 1959

Supervisor: Professor Wolfgang F. Michael

The choice of names for fictional characters is often a very important aspect of an author's art of characterization; however, except in a few cases, it is an aspect which has been ignored. Thomas Mann's use of significant naming in his fiction is as important as any other stylistic device he employs, yet it has never been given careful attention. This dissertation traces Mann's use of naming chronologically throughout all of his fiction, considering possible motivation for his various appellations and the effect of his name choice in characterization. It is limited in scope to the consideration of personal names, with only incidental references to place names. The introductory chapter offers a brief survey of naming in literature and some of the past and present theories of the importance of naming as a literary device. The main body of the study is devoted to interpretation and appraisal of the use made of the relationship between name-meaning and characterization. The chapter on the decade of the Joseph novels illustrates that Mann's interest in naming transcended the relatively utilitarian device of name-characterization and concerned itself deeply with the "mystery" of the name as an end in itself. The concluding chapter seeks an objective appraisal of Mann's overall naming technique. The index includes virtually all of the fictional names used by Thomas Mann.

The primary aspiration in this dissertation is to contribute significantly to the understanding of Thomas Mann's works. At the same time, it is hoped that this study will also serve to illustrate the applicability of Namenkunde or the study of names to literary criticism in general.

Microfilm $3.80; Xerox $12.80. 294 pages.

THE CORNELL JOYCE COLLECTION: A CATALOGUE.

(L. C. Card No. Mic 59-5299)

Robert Edward Scholes, Ph.D.
Cornell University, 1959

In the Spring of 1957 Mr. William G. Mennen acquired for Cornell University a collection of manuscripts, letters, and papers of James Joyce. Shortly thereafter significant additions to the collection were made by Mr. Victor Emanuel and Mr. C. Waller Barrett. All of this material came from the same source--the widow of James Joyce's younger brother Stanislaus. The source of the material accounts for its nature and its range. This is not a collection of books, but of private papers. It contains almost no material related to Joyce's life and work after 1920 when the two brothers ceased to be intimately connected, but is the richest collection in the world of material dealing with Joyce's life before that date, and of manuscripts of his juvenilia. The collection falls naturally into four sections: manuscripts (over sixty), letters of James Joyce (over two hundred and fifty), letters to or relating to James Joyce (nearly one thousand), and miscellaneous papers, photographs, and documents (seventy-five). The letters to Joyce include many from Ezra Pound, W. B. Yeats and other important literary figures of the early twentieth century.

The purpose of this catalogue is to make as widely available as possible a detailed statement of what is in the Cornell Joyce Collection. It is not enough for a scholar to know that there is a manuscript of "The Sisters" at Cornell. He must know what is its date and precedence, its relation to other manuscripts and published versions of that story. I have tried to answer as many questions of this nature as possible. Many of the manuscript items in this catalogue are fragmentary. By describing these items in considerable detail, I hope to enable a person with a related fragment to recognize the relationship. So that the listing of letters in this catalogue would be as useful as possible, missing dates have been supplied (in brackets) wherever they could be determined on the basis of internal evidence. And those people who wrote letters to James Joyce have been identified--in all but a few, especially difficult cases--and described in terms of their own achievements or their relationship to Joyce, or both, in brief sketches placed

before the listing of their letters. An index to the catalogue is provided.

In addition to its specific uses as a catalogue, this work is intended to have some general value as a contribution to Joyce bibliography in that it provides information about hitherto "lost" or unknown works by Joyce and supplies some new information about works which are well known. This catalogue is also intended to be a contribution to Joyce biography, providing material not readily available elsewhere about the residences of Joyce at different dates and about many friends and acquaintances of Joyce.

Microfilm $4.40; Xerox $14.80. 342 pages.

DREAMS IN THE NOVELS OF GALDÓS.

(L. C. Card No. Mic 59-4565)

Joseph Schraibman, Ph.D.
University of Illinois, 1959

The reader of Galdós' works cannot fail to notice the omnipresence of dreams in his novels, episodios, short stories, plays, and even in his journalistic writings. The ubiquity and importance of the dream have been noted by many reputable critics, among them L. B. Walton, William H. Shoemaker and Ricardo Gullón.

The present study is limited to an examination of dreams in the thirty-one social novels, i.e., the novelas de la primera época and the novelas españolas contemporáneas as Galdós himself divided them. The dreams were examined, not in isolation, but within the context of the novels with the purpose of determining their incidence, their manner of presentation, their function and the author's knowledge of dreams in the light of knowledge which came later.

It was found that the dream device is used in twenty-nine of the thirty-one social novels, written during the period 1870-1915, the exceptions being Torquemada en la hoguera (1889) and Torquemada en el purgatorio (1894).

The manner in which Galdós presents the dreams seems to vary both chronologically and with the type of novel in which the dream appears. With the exception of La sombra (1870), which anticipates many of Galdós' later techniques and of La familia de León Roch (1878) which marks a turning point in his use of the dream, all the dreams in the novelas de la primera época are narrated by the author. Beginning with La familia de León Roch and continuing through Angel Guerra (1890-91) many of the words of the characters are included in the dream accounts. In those novels written after Angel Guerra, the period which witnessed the decline in the importance of Galdós' use of the dream technique, the dreams are again narrated by the author with the exception of those in the novelas dialogadas El abuelo, Casandra and La razón de la sinrazón.

Galdós exploited the dream device in a myriad of ways and a single dream often serves more than one function. The first division that became apparent was that between dreams which depict events that are integral parts of the plot and those which do not. The "plot" dreams were further classifiable into dreams which depict events to come (Plot Anticipation 21), those which further the action (Plot Development 12), and those which recapitulate events already described (Plot Summary 9). Of these many remaining dreams, by far the greatest majority (one hundred and forty-four) can be said to serve the function of characterization. Many of these serve to remind the reader of the basic personality traits of a character. Others add depth to a character's portrayal by revealing the hidden drives and ambitions which motivate his behavior.

Galdós used the dream to depict the beliefs concerning the supernatural in his society. He also used it to give free rein to his imaginative powers by including in his oftentimes poetical account of a dream unique and shocking images which paradoxically, although created by Galdós' fanciful imagination, serve to render the dreams more credible as human experience.

Galdós seems to have known intuitively many of the facts about dreams later discovered by scientists. He was aware of the several levels of sleep, of the various types of dream phenomena, of the sources of dreams, both precipitating and essential, and of their manifest and latent content. He recognized the universal symbolism of the dream, he knew of "dream work"--the telescoping of time and space, and he gave evidence of having understood the relationship between the dream experience and the physical and mental health of the dreamer.

Microfilm $3.10; Xerox $10.60. 238 pages.

JOSÉ MARTÍ IN TRANSLATION.

(L. C. Card No. Mic 59-4205)

Eugene Chester Sneary, Ph.D.
Tulane University, 1959

Chairman: Daniel Wogan

José Martí, Cuban poet, essayist, orator and Apostle of his country's independence, is one of the brightest stars in the galaxy of Latin-American writers, and during the past sixty years his fame has spread to several European countries (France, Italy, Czechoslovakia and Russia) and even to Israel and China through the translations of his works. The purpose of this dissertation is to present existing bibliographical data concerning those translations and to analyze the effectiveness of the foreign versions in extending Martí's literary accomplisments beyond the Spanish-speaking world.

A Bibliography of Translations included in the study contains a total of 333 translations into eleven different languages, arranged to parallel the chapters in which the analysis of the translations themselves is discussed. Each translation is numbered and contains essential data for locating the poem, the date of its appearance, and the name of the translator.

The earliest translation of Martí's work appeared in 1898, three years after his death in the battle of Dos Ríos. These twenty poems in English were the only translations into any foreign language until 1918, when selected thoughts from Martí's prose writings were compiled and translated into English. During the period from 1920 to 1950, there were translations into French, Portuguese, English and a single poem into Hebrew.

Beginning in 1953, the centennial of his birth, a flurry of translation activity brought forth versions in Catalan, Chinese, Czech, Dutch, English, French and Galician, and subsequent translations into Italian and Russian. No

translation has been found in German, Greek, the Balkan nor the Scandinavian languages.

The analysis of the translations studied (and only the Chinese, Czech and Dutch versions were not available) reveals that, on the whole, the work of the translators has been conscientious and accurate in putting Martí's ideas and style into their respective languages. In the matter of form in poetry, there is considerable variety from one translator to another; some have maintained the form exactly, others have chosen an approximation of the original form, and often the form set by a translator has affected seriously other elements of the poem, especially the imagery. In the case of prose translations, the translators have been quite exact, even to transposing Martí's often highly oratorical style into the foreign language. Only the Russians have attempted to influence their readers via the translations, and this they have done through the selection of articles translated rather than by an distortion of what they translated. Only the English and the French have a really representative group of Martí's prose works, since the Russian offering is too biased and the Portuguese too limited in number. There are no published prose translations of Martí into the other languages dealt with in this study.

Microfilm $2.10; Xerox $7.40. 159 pages.

FRENCH TRANSLATIONS OF GOETHE'S FAUST II.

(L. C. Card No. Mic 59-4041)

Harry Linville Stout, Ph.D.
Indiana University, 1959

The three primary aims of this investigation were to discover how many French translations of Goethe's Faust II had been published, to investigate their relative and individual merits, and to determine whether a rendering clearly superior to all others had been made. As these translations are in themselves milestones in the French reception and interpretation of Goethe, they should consequently shed additional light on these broad problems.

Although some of the translators were or are well-known French men of letters, others are very obscure; in several cases little or no biographical information could be secured. Hence no attempt was made to supply extensive information on the lives of the translators; instead, attention was focused on the translations themselves.

Interest in providing the French people with a translation began shortly after Faust II's publication in Germany in its final form. This is evident from the fact that two translations, one of which was the result of three years' labor, were published in 1840. Afterwards interest fluctuated although new editions of the first complete translation appeared at frequent intervals. New renderings, largely in groups of two or three falling within the same decade, were issued in the following sequence: two from 1860 to 1869, one in 1891, two from 1905 to 1908, three from 1920 to 1923, and two from 1942 to 1949. There are twelve translations in all, of which eight are complete and another nearly so. Only three are entirely in verse although some of the others have verse passages. The verse translators endeavor, of course, to reproduce form as well as content; the prose translators are mainly concerned with accuracy and style. One verse translator, Pierre Masclaux (1923), wanted to give an entirely new interpretation to the Classical Walpurgis Night, and a prose translator, Alfred Mortier (1922), wanted to provide the French public for the first time with an accurate stage version of Faust, especially of Faust II.

Most translations--the present ones not excluded--suffer from almost inevitable handicaps: inaccuracies, omissions, shifts of emphasis, etc. The French translations of Goethe's Faust II exhibit such particular characteristics as use of general terms for specific ones, softening of earthy expressions, and, in the verse passages, monotony in rhyme and excessive padding. Translators often have trouble rendering compound nouns and overcoming obstacles inherent in the two languages, e.g., gender differences. Most works have the advantage of clarity; but one verse rendering, that of Pierre Bregeault de Chastenay (1948-1949), obscures the original.

Although no translation clearly superior to all others has yet appeared, four translations may, in spite of flaws, be said to be of high caliber. These works, all in prose, are the products of Henri Blaze (1840), Camille Benoît (1891), Suzanne Paquelin (1908), and Henri Lichtenberger (1920-1932). Microfilm $2.80; Xerox $11.20. 215 pages.

JESTING MOSES: A STUDY IN CABELLIAN COMEDY.

(L. C. Card No. Mic 59-5008)

Arvin Robert Wells, Ph.D.
University of Michigan, 1959

In this dissertation a study is made of the meaning of "comedy," as this term is applied by James Branch Cabell to a large number of his works. The first chapter sketches briefly Cabell's world-view, pointing out particularly the parallelism between his thought and the thought of such modern philosophers as George Santayana and Hans Vaihinger. Especial attention is drawn to the similarity between Cabell's concept of the elevated, detached viewpoint of the creative artist and Santayana's concept of the "disintoxicated" viewpoint of "spirit." The second chapter seeks to establish, through a brief comparison of Cabell's work with that of Miguel de Unamuno, that basically identical world-views may give rise to either a tragic or a comic vision, depending upon the author's assumed and felt relationship to his materials. Cabell's comic vision is seen as the result not primarily of Cabell's selection of materials but of his belief in the artist's Olympian viewpoint.

In the third chapter, Cabell's concept of comedy, insofar as this is inferrable, is elaborated and set in meaningful juxtaposition with other theories of comedy--e.g. those of Meredith, Bergson, James Feibleman and Albert Cook. Cabell's own concept is inferred from such occasional expository comments as he has made, extended and modified by reference to his world-view and to his practice. Cabell's concept of comedy is found to differ in several significant respects from other formally developed theories of comedy. Cabell conceives of comedy neither as a means of social castigation nor as an instrument in the service of social progress. For him the emphasis of comedy need not be social at all, and in his practice it is generally

individual: his comic types are psychological and metaphysical rather than social, and the pattern of his comedies is determined by the inner experience of the protagonist who is seen not as the member of a society but as a lone individual caught in the baffling flux of nature and of his own character. Cabellian comedy seeks to prepare for the reader a perspective in which he can view the "finite predicament" in the dual focus of irony, noting its beneficence as well as its malice, laughing freely--that is, with detachment--at the incongruities, the contradictions and the non sequiturs which arise out of the ironically benevolent interplay of illusion and instinct and time (flux).

The last chapter presents Cabell's comedies in chronological order, tracing through them the general development of Cabell's comic themes and techniques. In general, whereas in the pre-Cream of the Jest comedies the themes are reflected upon the plane of recognizable, if not ordinary, human experience, in the post-Cream of the Jest comedies ordinary human experiences are reflected upon the plane of myth and allegory where they become meaningfully related to broad psychological and metaphysical concepts. In the mature comedies, by a complicated blending of the Faust legend and the Odysseus legend and by the use of multi-aspect, supernatural beings drawn from and created out of the odds and ends of myth and folklore, Cabell manages to expose the exact conditions of the "finite predicament" in such a way that the predicament itself is assimilated as a necessary condition of the comic pattern.

Microfilm $3.00; Xerox $10.20. 229 pages.

AN INTRODUCTION TO THE PROBLEM OF "GESTURE" IN HEINRICH VON KLEIST AND HIS WORKS.

(L. C. Card No. Mic 59-5009)

Arthur Stevens Wensinger, Ph.D.
University of Michigan, 1959

Relatively few of Kleist's contemporaries and of modern Kleist scholars and critics have penetrated into what may be called the "Rätselhafte," "Stille," and "Wahre" of his nature; yet it would appear that these few have been correct in sensing that Kleist was a man who had almost apocalyptic visions into a medium of absolute communication, unencumbered by the confusion of words and the flow of rhetoric, and who, in a language quite unfamiliar to the drama and prose fiction of his time, was actually trying to incorporate these visions in his works. His singular message about man in "der gebrechlichen Einrichtung dieser Welt" is a message which resides more in the manner in which he speaks, paradoxically, through the manifestations of "das Unaussprechliche" than in any themes or summations. It is this which so decisively sets him apart from Goethe and Schiller, and which marks the advent of a new era in modern German Literature.

The important position of "gesture," in both the sense of Gebärdensprache and Sprachgebärde, has long been recognized, yet only desultorily studied, during the past half century. It resides stylistically in such elements as pantomime, specified or implied gesticulation, eloquent silence, uncompleted sentences, exclamations, and the like. Just as important, it resides within the very language of Kleist's drama and prose, not only in its pauses and its protestations of insufficiency. "Gesture" in Kleist demands and elicits a unique kinesthetic involvement.

The problem which is approached in this study is to discover what there was in Kleist which led him to abandon the conventions of the highly articulate literary tradition into which he was born and in which he lived--and to illuminate how the steadfast and tragic pursual of his inner dictates caused him to remain in his lifetime and long afterwards unrecognized as the momentous style innovator and "Gebärdendichter" (Max Kommerell) that he was. The purpose is to provide a prolegomenon to future "close reading" and interpretations of Kleist's plays and Novellen, which would aspire to elucidate, in detail, their cores of "gesture."

The primary concern of the study proper is to give a current evaluation of the hidden and unarticulated recesses of Kleist through an examination (in the form of a fairly lengthy Forschungsbericht) of modern scholarly and critical understanding of the role of "gesture" in his works (CHAPTERS I & II), through a detailed review of what his contemporaries said of him and of his writings (CHAPTER III-A), and, most important, through a new reading of Kleist's letters and certain of his short theoretical works (CHAPTER III-B & C). The second concern is to suggest by illustration, as the study proceeds, how this composite insight into Kleist's nature could be meaningfully applied to further studies of his works, in particular to his drama, where the juxtaposition and alternation of speech and nonverbal communication are most abundant. In an APPENDIX this approach is demonstrated on four important scenes from Penthesilea.

It is the study's CONCLUSION that, through a plurality of methods, such as a union of the "intrinsic approach" of certain of the American New Critics with the "Interpretation" of such European Literaturwissenschaftler as Emil Staiger and Wolfgang Kayser, and building upon the thorough foundation of the critical editions and the other contributions of positivism and biographical research, the material evaluated in this study might be brought into a new, intimate alliance with the works themselves. The energy still to be expended on Kleist studies might best be directed to the investigation of the meaningful complexities of his style, of which his language of "gesture" is one of the most fascinating manifestations.

Microfilm $4.85; Xerox $16.20. 380 pages.

THE ERIE CANAL IN FOLKLORE AND LITERATURE.

(L. C. Card No. Mic 59-4680)

Lionel Darcy Wyld, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. MacEdward Leach

It is no small wonder that the Erie Canal affected folklore and literature, for it was, for a considerable part of the nineteenth century one of the principal factors, economic as well as otherwise, in the daily life of a great many people. Like all monumental human experiences, it proved to be an influence of no minor importance upon the life, literature and culture of the people. The present study is a kind of literary history of the Erie Canal--of canal-produced folklore and of the uses of the canal and

canal life by belles-lettrists. The organization is largely by genre, with an assessment of Erie folklore and of the literature which the Erie accomplishment inspired. A glossary of Yorker terms and "canalese" is provided.

The stream of travellers from Europe who visited America during the first half of the nineteenth century found, after 1825, an attraction which had to be seen and experienced. Until the Civil War, when the tourist mania abated, foreign travellers came to York State to see the Falls at Niagara and Trenton, and, in the earlier period especially, the marvel of the Lockport Combines, the aqueducts, and other feats of engineering which the Erie Canal had to offer. Many of these persons were literary personages, and actors, actresses, and statesmen--persons who contributed, in diaries, journals and travel-books, to creating very early a body of Erie literature.

Native American writers, among them notables like the playwright William Dunlap, Melville and Howells, found in the Erie something interesting and usable; but not until Yorker regionalism reached out for mature expression did writers see in the canal a fruitful area for exploitation. Westcott's David Harum began the process; Edmonds' Rome Haul put the capstone on it. For this latter achievement, Edmonds might rightly be called "The father of the Erie novel."

The canal's influence on different areas of literature has been varied. Juvenile fiction, for obvious reasons, found the Erie story useful, and a number of creditable books, the vast majority within the last two decades, have appeared. In the drama, while the Erie appears in a few plays, its influence served more to affect culture in the main--through the touring troupes which brought theatre to upstate canal towns--than to provide inspiration for playwrights. For a time it was the subject of intensely patriotic, if not too profound, verse. Biographical works include the Erie only insofar as the canal touched the lives of the principals. The Erie Canal has, of course, been of greater influence on fiction than on any other genre. Two writers, especially,--Walter D. Edmonds and Samuel Hopkins Adams--have provided a substantial number of novels using canal life and lore. Adams, starting later, proved more sustaining, but Edmonds' highly productive "Erie years" are an enviable record, as well as a major influence for other writers.

In the area of folklore, recognizable Marchentypen exist in Erie versions, in addition to which, of course, numerous items of unique material are to be found. The folk characters, stories, legends, superstitions, and other elements of lore provide a rich cache for the folk historian and analyst. The "canal culture" in upstate New York was that of an especially interesting social group, one which had a limited mobility--the length of the canal--and which developed very early a group mores against which non-canallers were definite "outsiders," a sociological factor explored (or sometimes simply depicted) in some Erie fiction, beginning with Rome Haul. The canaller's sports and other activities provide an insight into his culture and folkways; Erie songs, too, which have never been assessed critically, offer much interesting material.

That the Erie Canal profoundly influenced the subsequent course of American history has been much reiterated; that it also had a significant effect on folklore and literature seems quite evident.

Microfilm $3.40; Xerox $11.60. 262 pages.

CONTEMPORARY FRENCH PHILOSOPHICAL LITERARY CRITICISM.

(L. C. Card No. Mic 59-5134)

André François Yon, Ph.D.
The Pennsylvania State University, 1959

Since World War II, the most important tendencies of French literary criticism have been to study literature from a philosophical point of view and to consider literature as a philosophical manifestation. These tendencies derive from the nature of contemporary literature itself and the role it has assumed in portraying man's existential experience. The purpose of this study is to examine the principal French philosophical and/or metaphysical literary critics of the period extending from 1944 to the present.

The Introductory chapter sketches a panoramic survey of traditional literary criticism from Aristotle's Poetics to its contemporary manifestations in France. This survey reveals that literary criticism is always based on a philosophy as a result of the close relationship existing between literature and a conception of man. Literary criticism, however, has progressively shifted the emphasis of its raison d'être from the evaluation of form and content of literature, as in neoclassical criticism, to the elucidation of the content of literature, as in the critical trend under consideration. It is in the light of existential philosophy, which provides a conception of total man, that Existence and Being as literary manifestations need to be elucidated. The two best examples of contemporary philosophical literary criticism are provided by Jean-Paul Sartre and Maurice Blanchot.

Sartre's literary criticism (Chapter II) is both negative and positive. It is negative when Sartre condemns traditional literature and criticism in such texts as "Présentation des Temps Modernes," "La Nationalisation de la littérature," and in part in Qu'est-ce que la littérature? It becomes positive in the latter text with the emergence of the concept of littérature engagée. Sartre's criticism is positive also in the formulation of existential psychoanalysis in L'Etre et le Néant and in the application of this critical method in Baudelaire and Saint-Genet. On the assumption that consciousness underlies human freedom and choices, Sartre's existential psychoanalysis is used to uncover Baudelaire's and Genet's "project" or original choice whose manifestations are phenomenologically described.

Blanchot's literary criticism (Chapter III), although it is established on existential principles, is the antithesis of Sartre's. In fact, Sartre favors the useful participation of literature in history, whereas Blanchot protects literature from history and devotes his research to the elucidation of the existential value of the literary act. Blanchot's fundamental principle is the description of the "Orphic search," or the quest for existence performed both by the writer and his work. Literary language, death, and experience are the elements involved in the Orphic search, which, in its totality, constitutes Blanchot's literary criticism as it appears in his essays, especially in L'Espace Littéraire, and in his articles of La Nouvelle Nouvelle Revue Française.

Between the two extremes of Sartre and Blanchot, other literary critics deserve to be mentioned in connection with

philosophical literary criticism. In Chapter IV, various critical systems are described and grouped according to their dominant preoccupation: the quasi-mystical investigation of Georges Bataille; the thematic criticism of Georges Poulet, Jean-Pierre Richard, and Roland Barthes; the ideological criticism of Maurice Nadeau and Claude-Edmonde Magny; the ethical criticism of R. M. Albérès and Pierre-Henri Simon; and the synthetic criticism of Gaëtan Picon.

In conclusion, it would appear that contemporary French philosophical literary criticism rightly deserves to be termed "philosophical." Its emphasis on the elucidation of literature as a means to investigate man's existential experience and the human condition in general as well as its lack of concern with esthetic considerations, indicate that literature is to be considered as a necessary value and guide for man rather than a mere entertainment.

Microfilm $4.70; Xerox $15.60. 365 pages.

LIBRARY SCIENCE

TERMINOLOGY, FORM, SPECIFICITY AND THE SYNDETIC STRUCTURE OF SUBJECT HEADING FOR ENGLISH LITERATURE.

(L. C. Card No. Mic 59-3116)

Oliver Linton Lilley, D.L.S.
Columbia University, 1959

This study was designed in part to gain information about some of the inherent characteristics of the alphabetical subject-heading system; and in part to identify a few of the practices that have been responsible for developing the one variety of the system (that based on the practices of the Library of Congress), now used in many American libraries. The data consisted of subject-headings, scope-notes, and references, in the subject-area of English literature, that have been employed by 18 sources: the Boston Athenaeum catalog (1874-1862); the three editions of the American Library Association list of subject headings; the six editions of the Library of Congress list; the seven editions of the Sears list; and the literature sections of the public catalog of the New York Public Library.

One of the findings was that a high degree of adaptability to variations of terminology, form, and specificity, and to different theories of syndetic needs, is a characteristic of the fundamental system. This indicates that the inadequacies of the subject-heading element of modern library catalogs more accurately can be attributed to the practices that have been adopted for its construction, than to any limitations imposed by its basic design.

With minor exceptions, the terminology and form of headings in this subject-area were found to be appropriate for the purposes for which they are employed. The nationality limitation adopted for this study reduced the range of specificity levels that were available for examination. But for those headings included within the sampling, the significant finding was that headings at the same level of specificity may be employed for such a wide variety of purposes that their exact uses are highly unpredictable on the basis of terminology and form alone.

For English literature headings, the syndetic apparatus was found to be at once the most important element, and the one least adequately provided for by modern subject-heading practices. Too few scope-notes and see-also references are employed, and too many general references, to ensure that library patrons will be able to make maximum use of the subject-heading element of the dictionary catalog. Microfilm $6.40; Xerox $22.20. 503 pages.

BOOK RESOURCES FOR TEACHER EDUCATION: A STUDY TOWARD THE COMPILATION OF A CORE LIST.

(L. C. Card No. Mic 59-4996)

Katharine Martin Stokes, Ph.D.
University of Michigan, 1959

This study is an attempt to compile a basic list of books which will be useful to librarians of teachers colleges building collections for fifth-year education of teachers as well as for undergraduate use. Studies of the materials used in master's theses and for graduate courses in education (many of them open also to undergraduates) at Western Michigan University and the School of Education at the University of Michigan revealed so many duplications that a core list of books seemed to be emerging. The card file built up for these materials was checked against published lists such as the annual ones compiled by the Education Department of the Enoch Pratt Free Library of Baltimore, with the advice of a group of education specialists, and printed in the May issues of the NEA Journal. A list of 1,019 items duplicated in the published sources was compiled and sent to twenty-five teacher-education institutions for checking against their library collections, six of them being colleges that offered no graduate work. The ten titles held by less than five libraries were dropped from the final list, as well as nine others that were not strictly within the limits set up for the study, leaving a core list of 1,000 items. The 602 titles which were among the holdings of twenty-one to twenty-six libraries are starred (*) as estimated to be the most important for retaining or acquiring, in both large and small collections, and in libraries supporting no graduate work in teacher education as well as in those that do, since at least one undergraduate institution had such items in its collection. Almost a fifth of the 1,000 titles were the product of two publishers, Harper and McGraw-Hill. Almost exactly a third appeared in the NEA Journal's annual lists. Half of them were published since 1950, and four-fifths of the other half since 1940. Microfilm $2.75; Xerox $9.60. 212 pages.

TOPICS IN INFORMATION THEORY.

(L. C. Card No. Mic 59-4483)

James Harman Abbott, Ph.D.
University of Illinois, 1959

In Chapter I an extension of the concept of conditional independence, which is used later, is introduced, and a new zero-one law is found. Chapter II is devoted to the mathematical foundations of generalized channel theory, and a setting is discussed in which input and output alphabets need not be finite, nor even countable. The power of modern probability theory is available in this setting, and new necessary and sufficient conditions for stationarity and ergodicity of the joint input-output process are found. Also, by using new techniques, a new sufficient condition for ergodicity in M-channels is derived. An M-channel, which is an extension of McMillan's (A, ν, B) channel, is defined in Chapter III. The results of Chapter II are applied to establish the mathematical foundations for M-channels and to obtain necessary and sufficient conditions for stationarity in this case. The definitions by Hinčin and Takano of types of channels are extended to M-channels. A new theorem relating Takano's t-step-dependence to d-independence is proved. A relation between types of conditional independence is shown which also shows that Hinčin's and Takano's ergodicity theorems follow from the new sufficient condition mentioned above. Chapter IV is devoted to uncertainty and entropy in discrete spaces and in the countable alphabet cases. Using "generalized" conditional expectation, the usual theorems are proved. The results of Shannon, McMillan, Flanagan, and Breiman on entropy per symbol are discussed and applied to the countable alphabet case. McMillan's finitary channels and sources are discussed in Chapter V. The relation of finitary channels to M-channels is shown. Blackwell, Breiman, and Thomasian's indecomposable channels and sources are discussed, and a theorem relating their memory and Hinčin's is proved which explicitly states the relationship they discussed. Feinstein's and Wolfowitz's channels are then shown to be both finitary and M-channels, and some relations are shown. Generalized channels and their capacity are defined in Chapter VI. Results on capacity by Tsaregradsky are stated and discussed, and some types of capacities are compared.

Microfilm $2.00; Xerox $5.80. 120 pages.

TWO INVESTIGATIONS ON THE BORDERLINE OF LOGIC AND ALGEBRA.

(L. C. Card No. Mic 59-4876)

Kenneth Ira Appel, Ph.D.
University of Michigan, 1959

The work in this paper is motivated by two questions propounded by Alfred Tarski.

Horn has shown (A. Horn, J. Symb. Logic, vol 16 p. 14) that any property expressible by a Horn sentence is preserved under direct product. Chang and Morel showed (C. C. Chang and A. Morel, J. Symb. Logic vol 23 p. 149) that this is not a sufficient condition in general. In the present paper, it is proved that any property preserved under direct product and expressible by a sentence of the predicate calculus with equality as the only predicate, is expressible by a Horn sentence of the form

$$\forall x_1 x_2 \ldots x_n \exists w_1 w_2 \ldots w_k \Lambda(\Lambda(x_i = w_j)) \supset (x_s = x_t).$$

The properties all concern cardinalities of models and the construction of the sentences utilizes properties of partitions of finite sets.

The second problem arose from group relational algebras. Let G be a finite group. A subring P of the group ring of G over the rational numbers is a partition ring provided that there exists a partition of G into subsets G_A and provided moreover, that there exist non-zero rationals m_g (one for each g in G) such that the elements $A = \Sigma_{g \in G_A}(m_g g)$ form a basis for P. One may assume, without loss of generality, that the m_g are integers and that for each G_A the greatest common divisor of the m_g for g in G_A is one. A canonical basis can then be defined for P. Thus one obtains a classification of all partition rings of the cyclic group of prime power order p^e.

The primary tool is a theorem which states that the set of basis elements of P is invariant under all power automorphisms of G. A second important concept employed is the partition of G into a sum of equivalence classes under the set of power automorphisms.

Some generalizations of the classification theorems to the case of general cyclic groups is obtained.

Microfilm $2.00; Xerox $3.80. 66 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

ANALYTIC AND COMPUTATIONAL ASPECTS OF DYNAMIC PROGRAMMING PROCESSES OF HIGH DIMENSION.

(L. C. Card No. Mic 59-4124)

Richard Edward Beckwith, Ph.D.
Purdue University, 1959

Major Professor: C. R. Hicks

Many important problems in engineering and economics may be formulated in terms of maximizing or minimizing a criterion function which involves the outputs of a system, of known characteristics. Control is to be exercised over the system by specifying one or more time-dependent parameters, called control functions or forcing functions, and to do so in such a manner that certain auxiliary constraints, which may be imposed on the system, are not violated. Problems of this type are usually characterized by high dimensionality; their solution, whether it be analytic or computational, is often a difficult matter.

It is the purpose of this thesis to develop procedures, through the application of the theory of dynamic programming, which expedite the computational solution of an important class of such control problems.

Specifically, we study various forms of the problem of extremizing the criterion function $H[x_1(T), \ldots, x_p(T)]$, which depends on p of the N components of the terminal solution x(T) of the vector-matrix differential equation $x'(t) = Ax(t) + v(t)$; given are the initial conditions and the constant N x N matrix A. Control is to be exercised over the above system by specifying the vector function v(t), the components of which may be required to satisfy given bounds and/or honor an integral constraint of the form $\int_0^T G(v_1, \ldots, v_N)dt \leq k$, a given number.

When H is linear in the components of x(T) we show how its maximization may be reduced to a routine involving the computation of sequences of functions of a single variable.

For the extremization of an arbitrary function H, the difficulty of the problem depends mainly on p, the number of components of x(T) that actually appear in the criterion function, not on the dimensionality N of the system. Dynamic programming considerations provide a numerical procedure for solving such a problem which involve the computation of sequences of functions of p arguments; a feasible procedure for p = 1 or 2.

For the important case where H and G are quadratic forms in the components of x(T) and v(t), respectively, and v(t) is not bounded, we contrast a method of analytic solution based on classical variational arguments with an improved analytic procedure based on dynamic programming considerations. The classical method requires the solution of a system of 2N ordinary linear differential equations, with given two-point boundary conditions, whereas the improved procedure necessitates only the solution of $\frac{1}{2}p(p + 1)$ ordinary nonlinear differential equations, with given initial conditions. This is a clear advantage when p is small and N is large, a feature of many important physical and economic problems.

It is shown how the methodology developed for the above model may be applied to processes governed by linear differential and difference equations with time-dependent coefficients, as well as certain linear difference-differential equations. We also indicate how the above theory may advantageously be applied to nonlinear models, by way of successive approximations.

The thesis includes introductory chapters on the theory of dynamic programming, control problems, and linear differential and difference equations. Convergence proofs are given for two of the computational processes which are studied in the paper.

Microfilm $2.90; Xerox $10.00. 223 pages.

A NEW GENERALIZATION OF A PROBLEM OF F. LUKÁCS.

(L. C. Card No. Mic 59-4599)

Louis Brickman, Ph.D.
University of Pennsylvania, 1959

Supervisor: Professor Isaac J. Schoenberg

Let $x(\chi)$ be a real valued non-decreasing function with infinitely many points of increase in the finite or infinite interval (a,b), and let the moments

$$\int_a^b \chi^v dx(\chi), \quad v = 0, 1, 2, \ldots,$$

exist. (These conditions permit the construction of a sequence of polynomials orthonormal in (a,b) with respect to $dx(\chi)$.) The natural number n being given, denote by Π_n the class of all real polynomials $f(\chi)$ satisfying

(1) degree $f(\chi) \leq n$

(2) $f(\chi) \geq 0$, $a < \chi < b$

(3) $\int_a^b f(\chi)dx(\chi) = 1$

In a paper soon to appear in Compositio Mathematica, I. Schoenberg and G. Szegő solve the problem of determining the set

$$R_z = \{ f(z) \mid f \in \Pi_n \}$$

where z is an arbitrary real number. The purpose of the present paper is to determine R_z when z is imaginary. Since Π_n is evidently a convex class, it is immediately observed that R_z is a convex set of complex numbers. It is also proved that R_z is compact. Hence the problem reduces to determining the function of support of R_z. This is accomplished with the aid of mechanical quadratures, and it is proved that R_z is the set bounded by a certain ellipse having a focus at the origin if $(a,b) = (-\infty, +\infty)$, and is the convex hull of the union of two such sets otherwise. These sets are precisely described in terms of orthonormal polynomials. (The cases n = 1, 2 are exceptional.) The variation of R_z with z is briefly studied and two continuity theorems are obtained.

Microfilm $2.00; Xerox $3.60. 61 pages.

THE BOUNDARY BEHAVIOR OF BLASCHKE PRODUCTS.

(L. C. Card No. Mic 59-4892)

Gerald Thomas Cargo, Ph.D.
University of Michigan, 1959

A Blaschke product is an infinite product of the form

$$B(z;\{a_n\}) = \prod_{n=1}^{\infty} \frac{|a_n|}{a_n} \frac{a_n - z}{1 - \bar{a}_n z},$$

where $0 < |a_n| < 1$ $(n = 1, 2, \dots)$ and $\sum_{n=1}^{\infty} (1 - |a_n|) < \infty$.

It is well-known that every Blaschke product is a holomorphic function which maps the open unit disk $d = \{z: |z| < 1\}$ into itself. Moreover, F. Riesz proved that a Blaschke product has radial limits of modulus one almost everywhere. In 1942 O. Frostman constructed a Blaschke product $B(z; \{a_n\})$ with the following property: Corresponding to each point $e^{i\theta}$, there is a subsequence of $\{a_n\}$, say $\{a_{n_k}\}$, such that $B(z;\{a_{n_k}\})$ does not have a radial limit of modulus one at $e^{i\theta}$. $B(z;\{a_{n_k}\})$ is called a subproduct of $B(z;\{a_n\})$.

This paper extends Frostman's result. For example, the following is proved: There exists a Blaschke product $B(z)$ such that, corresponding to each countable point set $\{e^{i\theta_n}\}$, there is a subproduct of $B(z)$ which does not have a radial limit at any point of $\{e^{i\theta_n}\}$. Moreover, it is shown that the class of countable point sets can be replaced by a larger class of sets.

The question of control on the complement of a countable point set is examined.

Some connections between radial limits and radial variation are established.

Finally, it is pointed out that the results of the paper also hold for the family of functions of the form

$$\exp\left[\sum_{n=1}^{\infty} b_n \frac{z + e^{i\Phi_n}}{z - e^{i\Phi_n}}\right],$$

where $b_n > 0$, $\sum_{n=1}^{\infty} b_n = 1$, and Φ_n is real.

Microfilm $2.00; Xerox $5.20. 103 pages.

FINITE GROUPS GENERATED BY UNITARY REFLECTIONS IN TWO DIMENSIONS.

(L. C. Card No. Mic 59-4900)

Donald Warren Crowe, Ph.D.
University of Michigan, 1959

The two-dimensional unitary space, U_2, consists of points $(x, y) = (x_1 + ix_2, y + iy_2)$ whose coordinates are complex numbers. The distance between (x, y) and (x', y') is defined by $[(x - x')\overline{(x - x')} + (y - y')\overline{(y - y')}]^{\frac{1}{2}}$. A unitary transformation is one which preserves distance. If $(x, y)\begin{pmatrix} r & s \\ t & u \end{pmatrix} = (x', y')$ is a unitary transformation the matrix $M = \begin{pmatrix} r & s \\ t & u \end{pmatrix}$ is a unitary matrix and it will be identified with the transformation. If M is unitary then $M^{-1} = \bar{M}^t$. A line is the set of points (x, y) satisfying some complex equation $ax + by = c$. A unitary transformation is a unitary reflection if it is of finite period n $(n > 1)$ and leaves a line pointwise invariant. That is, a unitary matrix represents a reflection if its two characteristic roots are 1 and a complex n^{th} root $(n > 1)$ of 1.

The primitive, irreducible finite groups generated by unitary reflections in U_2 are all generated by at most three reflections. We restrict attention to these in the sequel. It is apparent that these groups are closely related to the groups of displacements in elliptic 3 space (E. Goursat, Sur les substitutions orthogonales et les divisions régulières de l'espace, Ann. Sci. Ecole Norm. Sup. (3) 6 (1889), 9 - 102), in general by a 2:1 homomorphism. By writing the unitary reflections as quaternion transformations, $q' = aqb$, the details of this identification are carried out and tabulated. In the case of groups generated by three reflections the subgroups generated by pairs of these are also identified.

The groups generated by two reflections are groups of regular complex polygons. (G. C. Shephard, Regular complex polygons, Proc. London Math. Soc. (3) 2 (1952), 82 - 96) A number of inscription relations between various polygons are given. The diagonals of a polygon correspond to isocline planes in E_4. These planes are represented in a natural way as points on a sphere in E_3, which points are shown to be the vertices of a regular or quasi-regular polyhedron, the diagonal polyhedron of the polygon. The notion of regular quaternion polygon is introduced and a self-dual example, having 80 vertices, four on each edge, is studied in detail. Defining relations for its group of order 320 are given. Its "diagonal polytope" is the cross-polytope, β_5, in E_5.

Finally, generating reflections are found for the groups generated by three reflections in U_2. Defining relations for each group are given, in terms of these reflections. These reflections are chosen (except in one case where such a choice is proved to be impossible) so that the characteristic roots of their product determine the "exponents" of the group.

Microfilm $2.00; Xerox $4.00. 75 pages.

SCALAR TRANSFORMATIONS IN QUASI REFLEXIVE SPACES.

(L. C. Card No. Mic 59-4305)

Percy Mortimer Cuttle, Ph.D.
University of Oregon, 1959

Adviser: Paul Civin

In 1957 Errett Bishop formulated a spectral theory for operators on a reflexive Banach space and made a systematic study of scalar transformations. Bishop characterized scalar transformations on a reflexive Banach space in terms of T-measures, a generalization of the notion of characteristic vectors.

It is shown that Bishop's methods may be employed in the more general quasi reflexive Banach spaces of Civin

and Yood. Firstly it is shown that the definition of the integral, in the sense of Bishop, is valid in a quasi reflexive space. Secondly it is demonstrated that the set Q of all vector valued measures defined on the Borel sets of the complex plane to a quasi reflexive Banach space is itself a Banach space, and that the unit ball of Q is compact in the quasi weak operator topology.

Thirdly it is shown that a scalar transformation on a quasi reflexive Banach space may be characterized in terms of it's T-measures. The author concludes with a discussion of generalized spectral measures.

Microfilm $2.00; Xerox $4.00. 71 pages.

THE GEOMETRY OF THE UNIT SPHERE AND VARIATIONS OF REFLEXIVITY.

(L. C. Card No. Mic 59-4306)

Yvonne Germaine Marie Ghislaine Cuttle, Ph.D.
University of Oregon, 1959

Adviser: Paul Civin

Ky Fan and Irving Glickberg have defined and studied a large number of geometrical properties of the unit sphere in a normed linear space, most of which involved statements concerning the weak topology of the space under consideration. If this space is restricted to be the conjugate space X^* of a Banach space X, a collection of more general geometrical conditions can be obtained by replacing the statements involving the weak topology by corresponding statements about the weak* topology of the space X^*. A list of the properties resulting from this modification is drawn, and a number of equivalences existing between these conditions are proven.

The notion of "strong subreflexivity" is defined for a Banach space and is characterized in terms of certain subsets of the unit sphere of X^*. These subsets are also used in the study of rotundity and smoothness of the space X. By restricting the space X^* to be rotund or strongly sub-reflexive some additional equivalences are shown to exist among the more general geometrical properties referred to previously. Finally, quasi-reflexive Banach spaces are considered and studied in connection with strong subreflexivity, rotundity, smoothness and other geometrical properties.

Microfilm $2.00; Xerox $3.00. 47 pages.

BANACH ALGEBRAS OF INFINITE MATRICES, AND APPLICATIONS TO THE THEORY OF SUMMABILITY.

(L. C. Card No. Mic 59-4291)

Ervin Kenneth Dorff, Ph.D.
Lehigh University, 1959

Adviser: Professor Albert Wilansky

For any infinite matrix $A = (a_{nk})$, $n, k = 1, 2, \ldots$; define $\|A\| = \sup_n \sum_{k=1}^{\infty} |a_{nk}|$. Let Φ be the set of all A with $\|A\| < \infty$. Φ is a Banach algebra; a closed sub-algebra of the algebra of endomorphisms of m. The set Υ of all conservative A, and the set Δ of all conservative triangular A, are closed sub-Banach algebras of Φ. This dissertation is a study of these Banach algebras which arise naturally in summability theory and, in particular, an application of Banach algebra to the theory of summability.

For any sequence x, let (x) denote the set of all $A \in \Phi$ such that $Ax \in c$. In section 2 we prove that $x \notin m$ implies that both (x) is dense in Φ and $(x) \cap \Upsilon$ is dense in Υ. However, the corresponding result is not true in Δ. We obtain necessary and sufficient conditions for the sets (x), $(x) \cap \Upsilon$, $(x) \cap \Delta$ to be closed ideals, left ideals, right ideals, in the algebras Φ, Υ, Δ. We show that Φ, Υ and Δ are not separable, and that Φ and Υ are semi-simple while Δ is not. We conclude section 2 with a characterization of the extreme points of the unit spheres in Φ, Υ and Δ.

Section 3 is a further study of the algebraic properties of Φ and Υ. We show that Φ is dense algebra of linear transformations while Υ is not. Further, we show that Φ and Υ have minimal and maximal one-sided ideals, do not satisfy either the ascending or descending chain conditions on one-sided ideals, are primitive, and have a unique norm.

In section 4 we obtain a complete characterization of the radical of Δ. This leads to simple proof that Mazur's matrix is equivalent to convergence. Further, we study the quasi-radical of Δ, and determine the spectrum of a matrix which lies in a certain subset of Δ.

In section 5 we prove that a conservative matrix is compact if, and only if, it is coercive. This shows that every matrix in the radical of Δ is compact, and conversely for matrices with a zero diagonal.

Section 6 is a study of the maximal group of a Banach algebra, and in particular, the maximal group of Δ. We show that in the real case, the maximal group of Δ has an uncountably infinite number of components. If $A \in \Delta$, we show that A is a generalized divisor of zero if, and only if, A is not in the maximal group of Δ. We then study the elements on the boundary of the maximal group, and conclude by showing that every coercive triangular matrix is on the boundary of the maximal group of Δ.

In section 7 we give a new proof of the fact that a co-regular matrix cannot transform every bounded sequence into a convergent sequence.

We conclude the dissertation by offering an improvement of some known results.

Microfilm $2.00; Xerox $4.80. 95 pages.

ANALYTICAL TECHNIQUES FOR THE SOLUTION OF NON-LINEAR POWER SYSTEM EQUATIONS AND THEIR APPLICATION TO ECONOMIC PROBLEMS.

(L. C. Card No. Mic 59-4447)

Raymond William Ferguson, Ph.D.
University of Pittsburgh, 1959

The analysis of many power system planning and operating problems requires the determination of the

relationship among the voltage magnitudes existing at the various busses in the system, real and reactive power supplied at specified points to the system, and losses for a given system load level. While the network elements are normally characterized by linear relationships between the voltage and currents present at their terminals, the fundamental quantities of interest (real and reactive powers and voltage magnitudes) are related by nonlinear equations. These relations involve trigonometric functions of the bus voltage angles in addition to the voltage magnitudes and powers.

In many studies it is desirable to eliminate the angles from the equations and to simplify the relationships to obtain a more workable set of equations. These objectives are accomplished by expanding the classical equations for power entering a network about a known operating point in a power series in bus voltage magnitudes, bus voltage angles, and total system load power. By reversion of these series expressions for source powers, expressions are obtained for the fundamental variables (voltage magnitudes and angles and total system load powers) in terms of the real and reactive source powers. These series can be approximated by their terms up to the second order and provide a new tool for analysis of power system problems.

These quadratic equations provide the basis for finding the most economical dispatch of both real and reactive power for a given system load and voltage level. The coordination equations developed for solving this problem extend previous work that has considered only real power dispatch and provide a method for determining the best voltage levels at generating stations in order to assure that the reactive power requirements of loads and system losses are supplied in the most economical fashion.

As a practical application of these methods of power system analysis, digital computer programs have been prepared to calculate the coefficients of quadratic power system equations and to solve the coordination equations for finding the most economical dispatch of source real and reactive power.

Many further applications exist for the techniques used to develop the quadratic power system equations. They are directly applicable to voltage regulation studies, load flow studies, and the currently important problem of determination of loss formulas expressing system losses in terms of source real powers. The assumptions of constant source bus voltage angles and fixed linear relationships between real and reactive power normally made in developing loss formulas can be eliminated by obtaining a series expansion for total system load in terms of real power using the methods developed in deriving the quadratic power system equations.

Microfilm $2.00; Xerox $5.40. 106 pages.

ON POSITIVE REAL FUNCTIONS.

(L. C. Card No. Mic 59-4511)

Jack Leonard Goldberg, Ph.D.
University of Illinois, 1959

Functions which map the right half-plane into itself and take reals into reals - the so-called Positive Real functions - are studied by considering iterations of a transformation of P. Richards (A special class of functions with positive real part in a half-plane, Duke Mathematical Journal, Vol. 14, (1947), p. 779) which takes Positive Real functions into Positive Real functions. Let $f(z) = f_0(z)$ and

$$f_{n+1}(z) = \frac{(a_n f_n(z) - A_n z)}{(a_n A_n - z f_n(z))} \quad (n \geq 1) \qquad \text{where} \qquad A_n = \lim_{z \to a_n} f_n(z)$$

Let the polynomials P_n, Q_n, R_n, and S_n, be defined recursively by

$$\left.\begin{aligned} &P_{-1}(z) = 1,\ P_0(z) = 1, && P_n(z) = a_n P_{n-1}(z) + zA_n S_{n-1}(z) \\ &Q_{-1}(z) = 0,\ Q_0(z) = A_0 z, && Q_n(z) = a_n Q_{n-1}(z) + zA_n R_{n-1}(z) \\ &R_{-1}(z) = 1,\ R_0(z) = a_0 A_0, && R_n(z) = a_n A_n R_{n-1}(z) + zQ_{n-1}(z) \\ &S_{-1}(z) = 0,\ S_0(z) = z, && S_n(z) = a_n A_n S_{n-1}(z) + zP_{n-1}(z). \end{aligned}\right\} \quad (n \geq 1)$$

We prove, among other results:

(1) Theorem If f is Positive Real and $a_i > 0$ for $i = 0, 1, \ldots,$ and $a_0, a_1, \ldots,$ has one limit point in the open right half-plane, then each function in any of the sequences of rational functions

$$\frac{Q_n}{P_n}, \frac{R_n}{S_n} \qquad \text{and} \qquad \frac{(Q_n + A_{n+1} R_n)}{(P_n + A_{n+1} S_n)}, \qquad n = 0, 1, 2, \ldots,$$

is Positive Real and the sequences converge uniformly to f in any compact subset of the open right half-plane.

(2) Theorem Under the hypotheses of (1) and if

$$T(z)_n = P_n(z) f(z) - Q_n(z) \not\equiv 0$$

and

$$T^{\#}(z)_n = R_n(z) - S_n(z) f(z) \not\equiv 0$$

then $T(z)_n$ and $T^{\#}(z)_n$ vanish only at $z = a_0, a_1, \ldots a_n$ for Re $z > 0$ and their i-axis zeros are simple.

(3) Theorem Let N_i be the number of a_k which equals a_i $(k < 1)$. Then under the hypotheses of (2), the necessary and sufficient condition that there exist a Positive Real function, f, such that

$$f^{(N_0)}(a_0) = W_0, \quad f^{(N_1)}(a_1) = W_1, \quad \ldots, \quad f^{(N_i)}(a_i) = W_i, \ldots,$$

(the superscript N_i denotes the order of the derivative) is that the constants

$$A^{\#}_0 = f(a_0),\ A^{\#}_1 = \left[W_1 - \left(\frac{Q_{i-1}(a_1)}{P_{i-1}(a_1)}\right)^{(N_1)}\right] \div \left[\left(\frac{R_{i-1}(a_1)}{S_{i-1}(a_1)}\right)^{(N_1)} - W_1\right], \quad (i \geq 1)$$

be positive for $i = 0, 1, \ldots,$.

(4) Theorem Let

$$\epsilon_0 = \left| f^{(N_1)}(a_1) - \left(\frac{Q_1(a_1)}{P_1(a_1)}\right)^{(N_1)} \right|$$

and

$$\epsilon_1 = \left| f^{(N_1)}(a_1) - \left(\frac{R_1(a_1)}{S_1(a_1)}\right)^{(N_1)} \right|$$

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Then under the hypotheses of (3),

$$\lim_{\epsilon_0 \to 0} f(z) = \frac{Q_i(z)}{P_i(z)} \qquad \text{and} \qquad \lim_{\epsilon_1 \to 0} f(z) = \frac{R_i(z)}{S_i(z)}$$

The convergence is uniform in any compact subset of the open right half-plane.

Theorem (1) and (3) are analogous to theorems proved by J. Schur (Über Potenzreihen, die im Innern des Einheitskrieses beschränkt sind, Journal für die Reine und Angewandte Mathematik, Vol. 147 (1917) pp. 205-232 and Vol. 148 (1917) pp. 122-145) and R. Nevanlinna (Über beschränkte Functionen, die in gegebenen Puncten vorgeschriebene Werte annehmen, A. Acadamiae Sc. Fennicae (A), Vol. 13 (1919) pp. 1-71) for functions bounded in the unit circle. Theorem (4) generalizes a result that may be found in C. Caratheodory (Theory of Functions of a Complex Variable, Vol. 2 Chelsea, 1954), while Theorem (2) generalizes a theorem of S. Seshu and N. Balabanian (Transformations of Positive Real Functions, IRE Transactions on Circuit Theory, Vol. 4, (1957) p. 308). Microfilm $2.00; Xerox $3.00. 58 pages.

THE USE OF CHEBYSHEV MATRIX POLYNOMIALS IN THE ITERATIVE SOLUTION OF LINEAR EQUATIONS COMPARED TO THE METHOD OF SUCCESSIVE OVERRELAXATION.

(L. C. Card No. Mic 59-4512)

Gene Howard Golub, Ph.D.
University of Illinois, 1959

The purpose of this investigation is to show the relation between two iterative methods for solving linear equations for which the matrix of coefficients is symmetric, positive definite and possesses property (A) as defined by Young. The first method, the modified Chebyshev method, is a modification of a method derived by von Neumann and Stiefel in which the Chebyshev polynomial of a matrix related to the original matrix of coefficients is used to generate an approximation to the system of linear equations. The second method is the successive overrelaxation method of Young and Frankel.

For the modified Chebyshev method it is only necessary to use the previous approximant to compute a new approximant, whereas in the original process two approximants are needed to compute a new one. Furthermore, it is shown that to guarantee a fixed accuracy only about half the number of iterations are necessary.

The iteration formulas for the modified Chebyshev method and successive overrelaxation method are closely related. Indeed, it is shown that on a high speed digital computer under simple assumptions the modified Chebyshev method degenerates into the successive overrelaxation method. In addition, it is shown that to guarantee a fixed accuracy the modified Chebyshev method requires fewer iterations than the successive overrelaxation method.

The effect of roundoff is considered when the modified Chebyshev method and successive overrelaxation method are used to solve equations on a high speed computer. Bounds are established for the maximum contribution of the roundoff error for both methods.

A numerical example is given in which the modified Chebyshev method and successive overrelaxation method are used. It is shown that while the effect of the roundoff is initially small, eventually the analytical results are vitiated by roundoff error. Nevertheless, we conclude that the modified Chebyshev method should be used to solve linear equations for which the matrix of coefficients is symmetric, positive definite and possesses property (A).
Microfilm $2.00; Xerox $6.60. 140 pages.

A PROBLEM ON PARTITIONS WITH A PRIME MODULUS $p \geqq 3$.

(L. C. Card No. Mic 59-4627)

Peter Hagis, Jr., Ph.D.
University of Pennsylvania, 1959

Supervisor: Emil Grosswald, Ph.D.

Let $p \geqq 3$ be a prime, and let $a = \{a_1, a_2, \ldots, a_r\}$, where $1 \leqq a_i \leqq (p-1)/2$, be a set of r distinct integers. We are concerned with the problem of determining $p_a(n)$, the number of partitions of a positive integer n into summands congruent to $\pm a_i \pmod p$. This is a generalization of the problem first considered by Lehner, who took $p = 5$ and $r = 1$, and later studied by Livingood, who took $p > 3$ and $r = 1$. More recently both Petersson and Grosswald have obtained many results concerning $p_a(n)$ and other more general partition numbers. In the present paper the circle dissection method of Hardy and Rademacher is utilized, and a convergent series for $p_a(n)$ is obtained. We present this result here.

For $n \geqq A/12p$

$$p_a(n) = 2\pi \sum_{\substack{k=1 \\ k\equiv 0(p)}}^{\infty} \sum_{b_1=1}^{(p-1)/2} \sum_{\nu < \frac{B}{12p}} p_b(\nu) A_{k,b}(n,\nu) L_{k,b}(n,\nu)$$

$$+ \frac{\pi}{2^{r-1}} \sum_{\substack{k=1 \\ (p,k)=1}}^{\infty} \left(\prod_{i=1}^{r} \csc \pi\alpha_i/p\right) \sum_{\nu < \frac{r}{12}} c_a^{(k)}(\nu) B_k(n,\nu) L_k^*(n,\nu).$$

Here, $b = \{b_1, b_2, \ldots, b_r\}$ is obtained by a well defined mapping of a. $A = \sum_{i=1}^{r} (p^2 - 6pa_i + 6a_i^2)$, $B = \sum_{i=1}^{r} (p^2 - 6pb_i + 6b_i^2)$. α_i is defined by $\alpha_i k \equiv a_i \pmod p$, $0 < \alpha_i < p$. The $c_a^{(k)}(\nu)$ are coefficients in the Taylor expansion of a well defined function. $A_{k,b}(n,\nu)$ and $B_k(n,\nu)$ are finite sums of roots of unity.

$$L_{k,b}(n,\nu) = \begin{cases} \dfrac{(B-12\nu p)^{1/2}}{k(12np-A)^{1/2}} I_1\{\pi(12np-A)^{1/2}(B-12\nu p)^{1/2}/3pk\}, & \text{if } n > \dfrac{A}{12p}. \\ \dfrac{(B-12\nu p)\pi}{6pk^2}, & \text{if } n = \dfrac{A}{12p}. \end{cases}$$

$$L_k^*(n,\nu) = \begin{cases} \dfrac{(r-12\nu)^{1/2}}{k(12np-A)^{1/2}} I_1\{\pi(12np-A)^{1/2}(r-12\nu)^{1/2}/3pk\}, & \text{if } n > \dfrac{A}{12p}. \\ \dfrac{(r-12\nu)\pi}{6pk^2}, & \text{if } n = \dfrac{A}{12p}. \end{cases}$$

($I_1(z)$ is the Bessel function of the first order with purely imaginary argument.)

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The details involved in obtaining the above result are similar to those in the earlier papers of Lehner and Livingood.

Defining the set $\bar{a} = a \cup p = \{a_1, a_2, \ldots, a_r, p\}$ we next determine a convergent series for $p_{\bar{a}}^{-}(n)$, the number of partitions of n into summands congruent to elements of $\bar{a}$ or their negatives modulo p. The general procedure parallels that used in the investigation of $p_a(n)$, and the final result is quite similar to that stated above.

As the series for $p_a(n)$ and $p_{\bar{a}}^{-}(n)$ are extremely complicated it is worthwhile investigating the possibility of obtaining asymptotic formulas to approximate them for large n. In both cases k = 1 yields the dominant term in the expansion. We readily obtain the following result.

As $n \to \infty$

$$p_a(n) = \frac{\pi r^{1/2}}{2^{r-1}} \prod_{i=1}^{r} \csc \pi a_i/p \; \frac{1}{(12np-A)^{1/2}} \; I_1(\pi(12np-A)^{1/2} r^{1/2}/3p) \cdot (1 + O(e^{-\delta n^{1/2}}))$$

where $\delta > 0$. A similar result holds for $p_{\bar{a}}^{-}(n)$.

It is of interest to apply the results obtained to some particular sets a. We mention only one of these special cases here. If $p \equiv 1 \pmod 4$, a can be chosen so that $p^+(n;p)$ and $p^-(n;p)$, say, represent the number of partitions of n into quadratic residues and quadratic non-residues modulo p respectively. Using the asymptotic formula for $p_a(n)$ we obtain the following theorem.

As $n \to \infty$

$$\frac{p^+(n;p)}{p^-(n;p)} = \varepsilon^h \left(1 - \frac{\pi}{6}(3(p-1)/p)^{1/2} c\, \alpha_5(p) n^{-1/2} + O(n^{-1})\right).$$

Here h is the class number of the real quadratic field $R(\sqrt{p})$ and ε is its fundamental unit. $\alpha_5(p)$ is the number of representations of p by 5 squares, and c is a well defined constant. This result has previously been obtained by both Petersson and Grosswald.

While many of the results obtained in the present paper are not new, it is felt that the investigation is not without value. Theorems first proven by the function - theoretic method of Petersson have been shown to be obtainable by the simpler and more general circle integration method. We have here a clear indication that partition functions of great generality can be studied by using relatively simple analytic procedures.

Microfilm $2.00; Xerox $5.00. 100 pages.

STABILITY OF SET TRAJECTORIES IN A DYNAMICAL SYSTEM.

(L. C. Card No. Mic 59-4515)

Frank John Hahn, Ph.D.
University of Illinois, 1959

Let (X, G, F) be a topological transformation group where X is a topological space, G is a topological group, and F is a mapping of the cartesian product of G and X onto X. When G is the additive group of the reals the letter T is used instead of G and we have a dynamical system. Following E. Michael, topologies for spaces of subsets of X are defined. The most commonly used spaces are C(X), the collection of all compact subsets of X, and K(X), the collection of all closed subsets of X. In most cases X will be a metric space and C(X) and K(X) will have the Hausdorff metric.

The triples (C(X), G, $\mathcal{F}$) and (K(X), G, $\mathcal{F}$) are defined in a natural manner and it is proven that if X is a locally compact metric space and G a locally compact group then (C(X), G, $\mathcal{F}$) is a topological transformation group. It is also shown that if X is a locally compact metric space with a countable basis and G is locally compact then there is an equivalent metric on X such that (K(X), G, $\mathcal{F}$) is a topological transformation group. Some theorems on decompositions of the sets of K(X) are proven and it is shown that if X is an n dimensional manifold then X is not homeomorphic to C(X).

Following W. J. Trjitzinsky, the notions of a set trajectory being stable (+), stable (-), or stable are defined and the following theorems are proved. If X is a complete metric space and T is Poisson stable (+) on a dense subset of X then T is stable on a dense subset of K(X). If X is a complete metric space and $\varliminf_{t \to +\infty} d(A, tA) = 0$ on a dense subset of K(X) then T is stable on a dense subset of K(X).

Trjitzinsky has also conjectured that if X is a complete metric space and $\Phi : X \to K(X)$ is equivarient and $x \in \Phi(x)$ and if T is stable (+) on a dense subset of X then there is a residual in X such that

$$\varliminf_{t \to +\infty} d(\Phi(tx), \Phi(x)) = 0 \text{ and } \varliminf_{t \to -\infty} d(\Phi(tx), \Phi(x)) = 0.$$

This conjecture is proved true.

If G is the additive group of an n dimensional vector space over the reals and X is compact it is shown that each point of X has a non empty minimal center of attraction and this set is completely characterized. A concept of almost recurrence and weak center of X is developed and it is shown that the weak center is a center of attraction. Microfilm $2.00; Xerox $3.60. 63 pages.

TOPOLOGICAL PROPERTIES OF INTEGER VECTORS.

(L. C. Card No. Mic 59-4313)

Robert Edward Haymond, Ph.D.
University of Oregon, 1959

Adviser: Ivan Niven

The author presents some topologies for the set of n-dimensional vectors whose coordinates are rational integers.

The first is derived for the set of rational integers from a known topology for the positive integers. The method employed is that of using product and quotient topologies in conjunction with the usual method of deriving the integers from the positive integers. After having shown that this space is a connected T_1-space, the topology is extended to the set of n-dimensional integer vectors via the product topology.

The author then considers the problem of expressing

the set of integer vectors as a topological group. Specifically, an attempt is made to use a collection of subgroups as a basis for the open sets of the identity. It is found that the subgroups with dimension less than the space lead to a trivial topology, but that a non-trivial topology can be obtained from the subgroups with dimension equal to that of the space. In this case the space is shown to be metrizable T_4-space which is not compact and totally disconnected.

The same results are given for any finitely generated Abelian group by considering continuous homomorphisms of the previous space.

There is an appendix on Abelian groups.

Microfilm $2.00; Xerox $3.00. 29 pages.

PRODUCT INTEGRALS.

(L. C. Card No. Mic 59-4721)

Burrell Washington Helton, Ph.D.
The University of Texas, 1959

Supervisor: Professor H. S. Wall

This paper shows that the integral equation

$$f(x) = f(a) + \int_a^x fhdg ,$$

where $f(a) \neq 0$ and h and g are real valued functions on $[a,b]$ having rather weak boundedness conditions and the typical term of the approximating sum for $\int_a^x fhdg$ has one of the forms $f(x_{i-1})h(x_{i-1})[g(x_i)-g(x_{i-1})]$, $f(x_i)h(x_i)[g(x_i)-g(x_{i-1})]$ or $\frac{f(x_i)h(x_i) + f(x_{i-1})h(x_{i-1})}{2}$ $[g(x_i)-g(x_{i-1})]$, has a solution on $[a,b]$ if and only if for $a < x \leqq b$ a product integral of one of the types ${}_a\Pi^b(1+hdg)$, ${}_a\Pi^b(\frac{1}{1-hdg})$ or ${}_a\Pi^b \frac{1 + \frac{h}{2}dg}{1 - \frac{h}{2}dg}$, respectively, exists on $[a,b]$. Moreover, under these conditions and for $a < x \leqq b$ the product integral on $[a,x]$ is $\frac{f(x)}{f(a)}$. If $f(x) = f(a) + \int_a^x fhdg$ has a solution, $\int_a^x fhdg$ is a Riemann integral and the above mentioned boundedness conditions are satisfied, the three types of product integrals are equal for each subinterval $[a,x]$ of $[a,b]$.

Microfilm $2.00; Xerox $3.00. 36 pages.

CONVERGENCE FACTORS AND SUMMABILITY OF ORTHONORMAL EXPANSIONS.

(L. C. Card No. Mic 59-4150)

Syed Alamdar Husain, Ph.D.
Purdue University, 1959

Major Professor: Daniel Waterman

We consider an orthonormal system $\{\phi_\nu(x)\}$ in $[0,1]$, which is closed in C and bounded, independent of x.

By

$$f(x) \sim \sum_{\nu=0}^{\infty} c_\nu \phi_\nu(x)$$

we mean that $\sum_{\nu=0}^{\infty} c_\nu \phi_\nu(x)$ is an orthonormal expansion of f(x) in the system $\{\phi_\nu(x)\}$, i.e.,

$$c_\nu = \int_0^1 f(t)\phi_\nu(t)dt \quad (\nu = 0,1,2, \ldots).$$

J. Karamata and S. Aljancic have established a necessary and sufficient condition for the uniform convergence factors of the Fourier series and orthonormal expansions respectively of functions belonging to class C.

In chapter I we establish three theorems regarding the uniform convergence factors of the orthonormal expansions of functions belonging to classes B, $L^p (p > 1)$ and L respectively.

Let

$$\|\lambda_{\nu\mu}\|_0^\infty \qquad (\nu,\mu = 0,1,2, \ldots)$$

be an infinite matrix of real elements.
Now if

$$\Lambda_{\mu,x}(f) = \sum_{\nu=0}^{\infty} \lambda_{\nu\mu} c_\nu \phi_\nu(x)$$

converges uniformly for each fixed $\mu = 0,1,2, \ldots$, and

$$\lim_{\mu \to \infty} \Lambda_{\mu,x}(f) = \Lambda_x(f)$$

uniformly in x, then the orthonormal expansion of f(x) is said to be uniformly summable-Λ.

S. Aljancic has given necessary and sufficient conditions for uniform summability-Λ of the orthonormal expansions of functions in C.

In chapter II we establish necessary and sufficient conditions for the uniform summability-Λ of the orthonormal expansions of functions in the class B and L^p $(p \geq 1)$.

Let $\omega(\delta)$ be the modulus of continuity of f(x), and let $\Omega(\delta)$ be a continuous function of δ, $\Omega(\delta) \searrow 0$, and $\Omega(x + y) \leq \Omega(x) + \Omega(y)$, then there exists a function $f(x) \in C$ having its modulus of continuity $\Omega(\delta)$.

A function $f(x) \in C$ belongs to the class C^Ω, if

$$\omega(\delta) = 0(\Omega(\delta)), \qquad \delta \to 0.$$

R. Bojanic has generalized the theorem of Karamata in the following manner:

Theorem. If

$$\int_0^{2\pi} \Big| \sum_{\nu=0}^{n} K_\nu(t) \Big| dt = 0(1)$$

and

$$\Omega(\tfrac{1}{n})\int_0^{2\pi} |K_n(t)|\,dt = o(1),$$

then $\{\lambda_\nu\} \varepsilon (C^\Omega, C_F)$, i.e., if $f \varepsilon C^\Omega$ then $\sum_{\nu=0}^{\infty} \lambda_\nu c_\nu \phi_\nu(x)$ is uniformly convergent.

In chapter III we generalize the result of Bojanic by considering the orthonormal expansions of $f(x) \varepsilon C^\Omega$ and prove the following

Theorem. Let $\{\phi_\nu(x)\}$ be an orthonormal system in $[0,1]$, closed in C. If given an $\varepsilon > 0$, there exists an N and a $\delta > 0$ such that

$$\Omega(\delta)\int_0^1 |K_n(x,t) - K_m(x,t)|\,dt \leq \varepsilon$$

for all x, and $n,m \geq N$, then $\{\lambda_\nu\} \varepsilon (C^\Omega, C_F)$.

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QUASI-COMPLEXES.

(L. C. Card No. Mic 59-4938)

James Edwin Keisler, Ph.D.
University of Michigan, 1959

Quasi-complexes form an extensive class of spaces to which the Lefschetz fixed point formula applies. Complexes, snake-like continua, and finite products of quasi-complexes are quasi-complexes.

In this dissertation, it is shown that each quasi-complex, X, has a cofinal family, 0, of finite open coverings such that for each coefficient group the homology group of X is isomorphic with the homology group of the nerve complex of each member of 0. It is proved that if X possesses a cofinal family, U, of finite open coverings such that for each coefficient group the homology homomorphisms induced by the projection chain maps are onto maps, then X has a quasi-complex structure under a cofinal subfamily of U. This theorem is used in showing that certain spaces are not quasi-complexes. In particular, the T-like plane continuum formed by a ray which spirals down on a T is not a quasi-complex.

It is shown that quasi-complexes may be defined in terms of either the nerve complexes of coverings or the generalized Vietoris complexes of coverings. If a space, Y, is metric, a structure apparently weaker than the quasi-complex structure may be assumed which also implies that Y satisfies the Lefschetz Fixed Point Theorem.

It is proved that a homologically locally connected space, X, is a quasi-complex if and only if it possesses a cofinal family of finite open coverings such that for each coefficient group the homology homomorphisms induced by the projections are isomorphisms into. Using this result, it is shown that there exists a 2-dimensional quasi-complex in euclidean 3-space which is irreducible with respect to these properties, and that a quasi-complex may be the common boundary of three disjoint domains in euclidean 3-space.

Microfilm $2.00; Xerox $3.00. 54 pages.

MATRICES OVER POLYNOMIAL RINGS.

(L. C. Card No. Mic 59-5291)

David Brophel Lissner, Ph.D.
Cornell University, 1959

Let $R = F[x_1, \ldots, x_n]$ be the ring of polynomials in n variables over the field F. We consider the following three questions:

(1) Let A, B, and C denote 2 x 2 matrices over R, and $[A,B]$ the expression AB - BA. Is it true that $\mathrm{tr}(C) = 0$ implies that there exist matrices A and B such that $C = [A,B]$?

(2) Given a_1, a_2, and a_3 in R, let (a_1, a_2, a_3) denote the ideal generated by these three elements. Does d in (a_1, a_2, a_3) imply that there exists a 3 x 3 matrix with first row $\{a_1 a_2 a_3\}$ and determinant d?

(3) The special case of problem (2) for which d = 1.

The methods used consist for the most part of elementary operations with the polynomials involved, although we occasionally make use of the general theory of polynomial ideals and their manifolds.

The following results are obtained:

The answer to question (1) is 'yes' for polynomials in one variable over any field and also for polynomials in two variables over any algebraically closed field or any real closed field, and 'no' for polynomials in more than two variables over any field. The remaining cases for polynomials in two variables are still open.

Problem (2) is shown to be equivalent to a special case of problem (1), so the answer here is also 'yes' in all the cases mentioned above. Otherwise, we show that the answer is 'no' for polynomials in six or more variables over any field and for polynomials in three or more variables over a formally real field. The remaining cases are still open.

Since problem (3) is a special case of problem (2) the answer here is 'yes' whenever it was 'yes' before. In all other cases this question is still open.

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THE ORDER DUAL OF THE SPACE OF RADON MEASURES.

(L. C. Card No. Mic 59-4163)

John Eldon Mack, Ph.D.
Purdue University, 1959

Major Professor: Meyer Jerison

Let X be a locally compact space and denote the set of continuous real-valued functions with compact support on X by $\mathcal{K} = \mathcal{K}(X)$. The order dual of $\mathcal{K}$ is denoted by $L = L(X)$. Then L is the set of Radon measures on X. The set of elements of L which are norm-continuous as linear functionals on $\mathcal{K}$ is symbolized by L^b. The space L^b is a Banach lattice and it is the set of all bounded Radon measures on X.

Let $\mathcal{M}$ denote the norm dual of L^b. Then $\mathcal{M}$ is an (M)-space with strong order unit. It is shown in S. Kakutani,

Concrete representation of abstract (M)-spaces, Ann. of Math., vol. 42 (1941) pp. 994-1028, that this implies that there exists a compact space Y such that $\mathcal{m}$ is isometric and lattice-isomorphic with C(Y). By means of this isomorphism, the multiplication on C(Y) induces a natural multiplication on $\mathcal{m}$. With respect to this multiplication, $\mathcal{m}$ is a normed lattice algebra.

Let M denote the set of elements of $\mathcal{m}$ which can be extended to L as order bounded linear functionals. M is both a lattice ideal and a ring ideal of $\mathcal{m}$. We let $\mathcal{E}$ denote the set of idempotents of the ring M.

A quotient space of $\mathcal{m}$ can be identified with the set of all bounded real-valued functions on X. Hence each bounded real-valued function on X represents a whole class of elements of $\mathcal{m}$. For a given bounded real-valued function f, the equivalence class represented by f contains two distinguished elements (they may be equal) which we call f^* and f_*. For each bounded Radon measure μ, $f^*(\mu)$ and $f_*(\mu)$ are the upper and lower integrals of f with respect to μ. Moreover, if f is integrable with respect to every bounded Radon measure, then $f^* = f_*$. The results mentioned in this paragraph are generalizations of the theorems appearing in S. Kaplan, On the second dual of the space of continuous functions, Trans., Amer. Math. Soc., vol. 86 (1957), pp. 70-90.

Two elements a and b of a vector lattice are said to be disjoint if $|a| \wedge |b| = 0$. For $\mu \in L$, let $L\mu$ be the order closed lattice ideal generated by μ. Theorem: An order closed ideal in L equals $L\mu$ for some $\mu \in L^b$ if and only if every set of mutually disjoint non-zero elements of I is countable.

We find it useful to make the following assumption concerning X: (P) Each pseudocompact subset of X which is the closure of a σ-compact set is compact.

We remark that the spaces L and M are dual spaces. Let w(L,M) denote the weak topology induced on L by M. For $\mu \in L$, define $\|f\|_\mu = |f|(|\mu|)$ for each $f \in M$; then $\|\ \|_\mu$ is a pseudo-norm on M. Under the assumption that X has property (P), we can state the following theorem: Let A be w(L,M)-bounded subset of L and let $\mu \in L$, $\mu \geqq 0$. Then the following statements are equivalent: (i) The elements of A are equi-uniformly $\|\ \|_\mu$-continuous on each interval of M. (ii) The elements of A are equi-uniformly $\|\ \|_\mu$-continuous on each interval of $\mathcal{K}$. (iii) The elements of A are equi-$\|\ \|_\mu$-continuous at 0 on the set $\{d \in \mathcal{E} : d \leqq e\}$ for each $e \in \mathcal{E}$.

Again, assume X has property (P). Theorem: For a subset A of L, the following are equivalent: (i) A is relatively w(L,M)-compact. (ii) A is w(L,M)-bounded and for each $f \in M$, there exists $\mu \in L$ such that the elements of A are equi-uniformly $\|\ \|_\mu$-continuous on the interval $[-f, f]$. (iii) A is w(L,M)-bounded and for each $f \in M$, each $\varepsilon > 0$ and each family B of mutually disjoint elements of $\{\lambda \in L : |\lambda| \leqq |\nu| \text{ for some } \nu \in A\}$, the set $\{\lambda \in B : |f|(|\lambda|) \geqq \varepsilon\}$ is finite.

In the remainder of this abstract, X will denote a completely regular space. Let Λ be the order dual of C. The space Λ can be identified with an ideal in $L(\beta X)$ (βX denotes the Stone-Čech compactification of X). Let 1 denote the function in C which has the value 1 everywhere on X. For $\mu \in \Lambda$, let $\|\mu\| = |\mu|(1)$. Then $\|\ \|$ is a norm on Λ. Theorem: Λ is norm-complete if and only if X is pseudocompact.

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COMPACT ABELIAN TRANSFORMATION GROUPS.

(L. C. Card No. Mic 59-4645)

Lawrence N. Mann, Ph.D.
University of Pennsylvania, 1959

Supervisor: C. T. Yang

Floyd (Ann. of Math., vol. 66) proves the following theorem: If a toral group G operates on a compact manifold X with the reals mod 1 homology groups of a sphere, then the fixed point set F of G has the reals mod 1 homology groups of a sphere. In this paper the author shows that the above theorem is still true if the requirement that X be a manifold is dropped and corresponding homological properties of X assumed in its place. A homological manifold X with respect to R (reals mod 1) is defined as a locally compact, connected Hausdorff space of finite homological dimension with respect to R, which is of type P(R) (Yang, Trans. Amer. Math. Soc. vol. 87 (1958)) and is HLC over R. It is to be noted that the customary definition of homological manifold requires the finite Lebesgue covering dimensionality of X. This requirement is replaced by the less restrictive finite homological dimensionality of X. It is shown that the above theorem holds when X is a compact homological manifold with respect to R instead of a compact manifold. The proposition basic to this result is the following: If a finite solvable group G operates on a locally compact Hausdorff space of finite homological dimension with respect to R which is HLC over R, then the orbit space of G is also HLC over R. With this proposition the procedures of Floyd are used with slight modifications to obtain the desired result.

To complete the sharpening of Floyd's theorem it is shown that each component of the fixed point set of a toral group operating on a homological manifold with respect to R is also a homological manifold with respect to R. In order to obtain this result the author proves the following generalization of a theorem of Floyd's (Ann. of Math., vol. 65): Let G be a toral group operating on a homological manifold X with respect to R. Then if K is a compact subset of X, there are only a finite number of distinct isotropic subgroups G_x, $x \in K$.

The paper is divided into two parts. In Part I the special homology theory of P. A. Smith is formulated for the coefficient group Z_p (integers mod p) and some generalizations of results of Smith and Floyd are proven. In Part II the author turns to the coefficient group R. As in Part I a special homology theory is formulated, but now for the coefficient group R. This special homology theory may be found in a paper by Yang ("p-adic transformation groups", unpublished). The author proceeds in Part II to prove his main results.

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POSITIVE REAL FUNCTIONS.

(L. C. Card No. Mic 59-4534)

Jerry Chalmers McCall, Ph.D.
University of Illinois, 1959

A positive (P) function is analytic in the open right half-plane and maps this half-plane into itself. A positive real (PR) function is a P function which also maps the positive real axis into itself. PR functions play an important role in electrical network synthesis. (See Guillemin, E. A., Synthesis of Passive Networks, John Wiley and Sons, 1951.)

In the following theorems s_1 and $s_0 \neq s_1$ are points in $\gamma > 0$, $Z_1 = Z(s_1)$, and $H_1 = H(s_1)$. Given a P function, $Z(s) = R + iX$, $S = \gamma + i\omega$, let C be the member of the hyperbolic pencil of circles, whose limiting points are s_1 and $-\overline{s}_1$, which passes through s_0. Let D be the member of the hyperbolic pencil, whose limiting points are Z_1 and $-\overline{Z}_1$, which encloses Z_1 and which satisfies:

$$\text{(Radius of C)} / \text{(Radius of D)} = \gamma_1 / R_1 .$$

(1) Theorem Either Z(s) maps C closure into D interior or $\overline{Z(s)}$ is the function,

$$Z(s) = \frac{Z_1(s + \overline{s}_1) + \overline{Z}_1(s - s_1)\, e^{i\sigma}}{s + \overline{s}_1 + (s_1 - s)\, e^{i\sigma}}, \quad \sigma \text{ real}$$

which maps C closure onto D closure.

(2) Theorem If Z(s) is PR and $\arg s_0 \neq 0$ then either Z(s) maps the intersection of C closure with $|\arg s| \leq |\arg s_0|$ into the intersection of D interior with $|\arg Z| < |\arg s_0|$ or Z(s) is one of the functions, $Z(s) = Z_1\, s/s_1$, $Z(s) = s_1 Z_1/s$, each of which maps the first intersection onto the closure of the second intersection.

(3) Corollary In the foregoing theorem let $s_0^* = \gamma_0^* + i\omega_0^*$ be the point of intersection, farthest from the origin, of C and the radial line passing through s_0, and let the relation $\sqrt{|s_0^*|^2 + s_1^2} = \gamma_0^* \sqrt{2}$ be satisfied. Then, if $|X_0|\, s_1 < |\omega_0^*|\, Z_1$ should fail to hold, Z(s) is one of the functions, $Z(s) = Z_1\, s/s_1$, $Z(s) = s_1 Z_1/s$, in which case $|X_0|\, s_1 \leq |\omega_0^*|\, Z_1$ holds.

Given a semi-circle A in $\gamma > 0$, whose endpoints are $i\omega_1$ and $i\omega_2$, $\omega_2 > \omega_1$, and given a semi-circle B in $R > 0$, whose endpoints are iX_1 and iX_2, $X_2 > X_1$, then Z(s) is a generalized positive real (GPR) function if it is a P function which maps A into B.

(4) Theorem If Z(s) is a GPR function and s_0 is in $\gamma > 0$ but not on A, let Γ be the member of the elliptic pencil of circles, whose common points are $i\omega_1$ and $i\omega_2$, which passes through s_0. Let α be the acute angle at which Γ meets the line $\omega = \omega_2$. Let Γ' be the member of the elliptic pencil, whose common points are iX_1 and iX_2, which passes through $Z(s_0)$. Let β be the acute angle at which Γ' meets the line $X = X_2$. Then either $|\beta| < |\alpha|$ or Z(s) is a Moebius transformation.

In the following theorems Z(s) and H(s) are PR functions and s_1 is a positive real number.

(5) Theorem If H(s) is schlicht and if $Z = F(H) = Z(s(H))$ is PR, where s(H) is the inverse of H(s), then

$$\psi(s) = \frac{Z(s)\, H(s) - Z_1 H_1}{Z_1\, H(s) - H_1\, Z(s)}$$

is PR, provided $Z_1 H(s) \neq H_1 Z(s)$, $Z(s)\, H(s) \neq Z_1 H_1$.

The special case, $H(s) = 1/s$ and $s_1 = 1$, has been given by P. I. Richards ("A Special Class of Functions with Positive Real Part in a Half-Plane," Duke Mathematical Journal, Vol. 14, pp. 777 - 785, 1947).

(6) Theorem The function,

$$\psi(s) = \frac{Z(s)\, H(s) + 2H_1 Z(s) + Z_1 H_1}{Z(s)\, H(s) + 2Z_1 H(s) + Z_1 H_1}$$

is PR, provided $H_1 Z(s) \neq Z_1 H(s)$.

(7) Theorem The following function is PR:

$$\psi(s) = \frac{2Z(s)\, H(s) + H_1 Z(s) + Z_1 H(s)}{H_1 Z(s) + Z_1 H(s) + 2Z_1 H_1} .$$

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ON APPROXIMATIONS OF THE SOLUTIONS OF THE GOURSAT PROBLEM FOR SECOND ORDER QUASI-LINEAR EQUATIONS.

(L. C. Card No. Mic 59-4964)

Robert Hanson Moore, Ph.D.
University of Michigan, 1959

The problem considered is given by the hyperbolic partial differential equation (1) $u_{xy} = f(x,y,u,p,q)$, where $p = u_x$ and $q = u_y$, with the conditions (2) $u(x,0) = s(x)$, $u(0,y) = t(y)$ prescribed along the characteristics $x = 0$ and $y = 0$. A function $u(x,y)$ is sought which satisfies (1) and (2) on a rectangle R: $0 \leq x \leq a$, $0 \leq y \leq b$. This problem is analogous to finding the function $y(x)$ which satisfies the ordinary differential equation (3) $y' = f(x,y)$ on the interval I: $0 \leq x \leq a$ and the initial condition (4) $y(0) = c$. The thesis is in two parts, each part concerned with exploiting this analogy.

The principal theorem of Part I concerns the convergence of approximate solutions to a true solution of (1) and (2). Consider sequences of successively finer meshes M^n in the rectangle R and corresponding sequences of successively finer meshes M_V^n in the space V: $-\infty < u < \infty$, $-\infty < p < \infty$, $-\infty < q < \infty$. Define a sequence $\{K_n(x,y,u,p,q)\}$ of functions subject to the conditions that K_n is constant on each cell of the product mesh $M^n \times M_V^n$ in R x V and, as $n \to \infty$, K_n approaches f uniformly. If (1) and (2) are replaced by an equivalent system of integral equations in u, p and q, and f in each integral is replaced by K_n, one obtains, for each n, a system of "approximate solutions" U_n, P_n and Q_n defined on the nodes of M^n. The values of these functions at each node are expressed as simple summations depending on their values at preceding nodes (in the

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natural partial ordering of the nodes). If f is continuous on R x V and satisfies a lipschitz condition in p and q, then as $n \to \infty$, the sequence $\{U_n\}$ converges uniformly (in a suitably defined sense of the word) to a continuous function on R which solves the problem given by (1) and (2). The approximate solutions given by Diaz [Arch. Rat. Mech. Anal. vol. 1 (1958) pp. 357-390] as analogs of the Cauchy-Euler polygons for $y' = f(x,y)$ can be obtained by a suitable specialization of the K_n and a bilinear interpolation of values between the values of U_n at the mesh nodes.

A further theorem of Part I asserts that every solution can be found as the limit of approximate solutions of the type described, even if f is such that the problem given by (1) and (2) does not have a unique solution.

Part II is concerned with developing a numerical process for (1) and (2) which is quite similar, both in application and order of accuracy, to the Runge-Kutta process for (3) and (4). For this purpose, equation (1) is transformed into the equation (5) $DU = \Phi(U)$, where, in the notation of vectors and matrices, $U = \mathrm{col}(x,y,u,p,q)$, $\Phi(U) = \mathrm{col}(1,1,f(U),f(U),f(U))$, $D = \mathrm{diag}(\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial^2}{\partial x \partial y}, \frac{\partial}{\partial y}, \frac{\partial}{\partial x})$.

The analogy between (5) and (3) is apparent. The proposed numerical method for solving the partial differential equation is essentially a process of approximate integration of (5) over each subrectangle of the mesh M^n on R. As in the usual Runge-Kutta procedure for (3), f is evaluated several times for each approximate integration, in general fifteen times, although fewer such evaluations are needed if not all of u, p and q appear as arguments of f. The convergence of the complete process depends on the theorem in Part I outlined above.

Microfilm $2.00; Xerox $4.80. 93 pages.

SOME PROPERTIES OF LINEAR FUNCTIONALS IN A REGULAR MATRIX SPACE AND THE SPACE OF BOUNDED SEQUENCES.

(L. C. Card No. Mic 59-4460)

Samuel Park, Ph.D.
University of Pittsburgh, 1959

For any infinite matrix, define $\|A\| = \sup_n \sum_{k=1}^{\infty} |a_{nk}|$. Let $\mathfrak{B}$ be the set of all matrices A with $\|A\| < \infty$. Then $\mathfrak{B}$ is a Banach algebra. Let (m) be the Banach space of all bounded sequences x with the norm $\|x\| = \sup_n |x_n|$. Each element in (m) defines a linear functional on a subspace of $\mathfrak{B}$. This dissertation has investigated some of the properties of these functionals by investigating the domains of these functionals and conversely. Originally the following question has been raised: Is there a linear functional which can be represented by a consistent class of regular matrices defined on (m)?

Even though the original problem is still to be solved, the following are some pertinent results:

(1) For each regular matrix A, let D(A) be the set of all bounded sequences which are A-limitable. Then there is no denumerable class of regular matrices $A_1, A_2, \ldots$ such that $\bigcup_{n=1}^{\infty} D(A_n) = (m)$.

(2) For any denumerable consistent class of regular matrices $A_1, A_2, \ldots$ with norms uniformly bounded, and an arbitrary sequence $x \in (m) - \bigcup_{n=1}^{\infty} D(A_n)$, and a real number ξ, there is a consistent class which contains the given class and sums x to the value ξ.

(3) Let C_1 be the C_1-matrix. For any bounded complex sequence x, let Q be the closed convex hull of the limit points of x. Then every C_1-limit of a subsequence of x is in Q and for any $\xi \in Q$ there is a C_1-limitable subsequence of x which in C_1-limitable to ξ.

(4) Let m_A and C_A be the sets of all sequences, bounded or not, whose A-transform are bounded and convergent respectively. Let $\mathcal{A}$ be any set of regular matrices. Let $\ell_\rho(A)$ be the set of all regular matrices which include A. If $D(x)_n \cup_{A \in \mathcal{A}} \ell_\rho(A) \subset D(y)_n \cup_{A \in \mathcal{A}} \ell_\rho(A)$, where $x,y \in \bigcup_{A \in \mathcal{A}} m_A$, then either $x = z^{(1)} + z^{(2)}$ for some $z^{(1)}$, $z^{(2)} \in \bigcup_{A \in \mathcal{A}} C_A$ or there is a unique real number α and a sequence $z \in \bigcap_{A \in \mathcal{A}} C_A$ such that $y = \alpha x + z$.

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CONTRIBUTIONS TO ESTIMATION IN A CLASS OF DISCRETE DISTRIBUTIONS.

(L. C. Card No. Mic 59-4968)

Ganapati Parashuram Patil, Ph.D.
University of Michigan, 1959

It is first shown that the binomial, Poisson, negative binomial and logarithmic series distributions can be regarded as special cases of a general class of discrete distributions which we refer to as generalized power series distribution (gpsd). It is then possible to examine the work on estimation in the case of the above discrete distributions from a general point of view. The approach in this thesis is to derive results for this general class of distributions and then apply them to the special cases of binomial, Poisson, etc.

To begin with, a few results which bring out some interesting properties of a gpsd are presented. An explicit functional relationship between the variance and mean of a gpsd is discovered and based on this fundamental relation, some characterization theorems are presented. To mention one, it is established that the equality of variance and mean is necessary and sufficient for a gpsd to be Poisson.

Next, certain estimation problems connected with a gpsd are investigated. It is shown that the maximum likelihood method and the method of moments give the same estimate when the gpsd involves a single parameter. A computational method for evaluating the maximum likelihood estimate is developed which requires only a table of values of the mean of the gpsd for various values of the parameter at sufficiently close intervals. It is shown how the standard error of the estimate can be approximately evaluated by using this table. The formulae for the amount of bias in the likelihood estimate are obtained to the order of $\frac{1}{N}$ where N is the sample size.

Large sample methods based on maximum likelihood are then derived for testing the homogeneity of several distributions and providing the estimate for the common parameter in case the distributions are homogeneous. The likelihood equation and a method for solving it are derived for the problem of estimation in censored forms of a gpsd. Methods based on the maximum likelihood principle are given for the treatment of doubtful observations. The problem of estimation when the gpsd involves two parameters has been considered.

For the gpsd, in addition to the maximum likelihood estimate, two other simple estimates are provided. One is called the "Two-Moments Estimate" and is derived by equating the first two sample moments to the corresponding population moments. The other estimate is called the "Ratio Estimate" as it is obtained by taking the ratio of two suitably constructed linear functions of frequencies such that the ratio of the expected value of the numerator to that of the denominator is equal to parameter. Expressions are derived for the bias and variance of these two estimates correct to terms of order $\frac{1}{N}$ where N is the sample size.

Lastly, the results obtained by general approach are applied to specific distributions - namely, the binomial, Poisson, negative binomial and logarithmic series. In each case, numerical tables are given to facilitate computation of the maximum likelihood estimate. The bias and efficiency of the "Ratio" and "Two-Moments" estimates are numerically evaluated for different values of the parameter and recommendations are given for the suitability of the different methods of estimation. Illustrative examples have been worked out in detail to illustrate the methods suggested.

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LINEAR TRANSFORMATIONS AS INTEGRAL TRANSFORMATIONS WITH DISTRIBUTIONAL KERNELS.

(L. C. Card No. Mic 59-4549)

Paul Robert Peabody, Ph.D.
University of Illinois, 1959

In a paper entitled "Theorie des Noyaux,"[1] L. Schwartz pointed out that a great many of the classical linear transformations in function space could be represented as integral transformations with a distribution as kernel, hereafter called kernel representations for short. These transformations include linear differential and difference transformations as well as the classical linear integral transformations. Schwartz states as a theorem that necessary and sufficient conditions for such a representation to exist is that the given transformation possess a certain continuity property, which is called weak continuity in this paper.

It is noted that each of the kernels in these examples has the formal representation $K_{x,t} = L\delta_{x-t}$, where L is the linear transformation, δ_{x-t} is the Dirac-delta distribution, and $K_{x,t}$ is the kernel. This observation gives credence to the following argument. From the defining property of δ_{x-t}, we have $\phi = \phi(t) \cdot \delta_{x-t}$. Then if L and integration with respect to t commute in some sense,

$$L\phi = L[\phi(t) \cdot \delta_{x-t}] = \phi(t) \cdot L\,\delta_{x-t}. \qquad (1)$$

The purpose of this paper is to make the above argument rigorous, thus obtaining rules for constructing the kernels of the integral transformations when such a kernel representation exists.

Section 1 details the summary above, lists examples, and provides an introduction to the topics discussed.

In Section 2, certain basic results involving distributions are obtained. The convolution product of certain pairs of distributions is defined, and the properties of the convolution product briefly sketched. Indefinite integrals of a certain class of distributions are defined in terms of convolution products, and a generalized indefinite integration-partial differentiation operator D^r, where r is a p-dimensional vector, is introduced. The order of a distribution over a finite p-dimensional rectangle R is defined, and it is shown in essence that for every R and every distribution U there exists a "least primitive" f of U on R such that f is locally summable and $D^n f = U$, where n is the order of U on R. A class of pseudo-scalar products of certain pairs of distributions are defined, which reduce in special cases to the ordinary concept of scalar products. Finally, a simple proof of the theorem of Schwartz noted above is obtained.

These results are used in Section 3 to show that if L is a weakly continuous linear transformation from the space D of Schwartz into the space of distributions, then L has an extension to a certain class S of functions which includes D properly. A representation of the kernel in terms of this extension is then obtained.

This theory is deficient in that it presupposes a knowledge of the kernel before the representation of the kernel may be obtained. Stronger results hold whenever the original transformation is defined on a larger class than D, and it is shown that under necessary and sufficient conditions related to the condition of weak continuity a kernel representation exists and the kernel is obtained explicitly from the known properties of the transformation.

This theory is simplified in Section 4 for a class of transformations which have a representation as a convolution transform. In particular it is shown that in order for a weakly continuous linear transformation to have a representation as a convolution transform, it is necessary and sufficient that $L(\phi * \theta) = L\phi * \theta = \phi * L\theta$, for all ϕ and θ in D, where * denotes the ordinary convolution product.

The properties of linear transformations admitting kernel representations is studied to some extent in Section 5 by examining the corresponding properties in the calculus of distributions. The most important results deal with the existence of a kernel representation of the transformation inverse to a given transformation which has a kernel representation, and with the representation of the inverse kernel in terms of the original transformation when the original transformation is a product or sum of transformations.

Although the basic theory of distributions is assumed known, an Appendix is provided listing some of the major properties which are used without proof in the text.

Microfilm $2.00; Xerox $3.00. 57 pages.

1. Schwartz, L. Theorie des Noyaux, Proceedings of

the International Congress of Mathematicians, Vol. 1, pages 220-230, Cambridge, Mass., (1950).

THE USE OF LEAST FAVORABLE DISTRIBUTIONS IN TESTING COMPOSITE HYPOTHESES.

(L. C. Card No. Mic 59-4975)

Howard Earl Reinhardt, Ph.D.
University of Michigan, 1959

The usual method of finding a most powerful size α test of a composite hypothesis against a simple alternate is to guess a Least Favorable Distribution (L. F. D.) - introduced at various levels of generality by Neyman and Pearson, Wald, Lehmann and Stein. Correctly guessing the least favorable distribution reduces the problem to that of testing a simple hypothesis against a simple alternate. The purpose of this study is to investigate the nature of least favorable distributions and to use the properties to reduce the amount of guessing.

In particular, the research was undertaken in the hope of finding an explanation for a method Lehmann and Stein used in studying hypotheses about the variance of a normal distribution.

First a review of the classical theorems of hypothesis testing is given, and standard techniques are applied to get certain additional results. In particular, it is shown that under quite general conditions, a hypothesis testing problem can be changed, without changing its solution, so there is a least favorable distribution.

The notion of uniformly least favorable distribution (U. L. F. D.) is introduced. It is shown that a U. L. F. D. is a point in the convex set of mixtures of the hypothesis which is the closest (in the sense of the $\mathfrak{L}'$ norm) to the alternate. The condition is not sufficient. More generally, it is shown that an L. F. D. is a point in the expansion or contraction of the set of mixtures which is closest to the alternate. In the case U. L. F. D.'s exist the U. L. F. D. for n observations, knowing it for one observation, is derived.

A sufficient condition for U. L. F. D.'s when the distributions depend on a "nuisance" parameter is, essentially, that the nuisance parameter can take on the same values in the alternate as in the hypothesis. This sufficient condition is satisfied by the problem considered by Lehmann and Stein and leads to a natural solution of that problem.

In case no U. L. F. D. exists, any distribution is least favorable for a closed set of α's. (A pathological example shows that this closed set need not be the union of a finite number of closed intervals.)

Using this, it is sometimes possible to produce the most powerful test using a step by step process. This is done for tests on the uniform distribution and for tests about points of truncation of a truncated distribution. In the concluding sections some counter-examples are given, and the relations between the problem investigated and some other statistical and mathematical questions are briefly considered.

Two disadvantages of the method of L. F. D.'s are apparent. The method replaces a problem that has a solution by one that may not and this substitute problem implies finding a point of smallest $\mathfrak{L}'$ norm in a convex set. Further, the sufficient conditions for L. F. D.'s are weak enough that counter-examples are easy to construct. These two facts indicate that a more direct approach might be more fruitful.

Microfilm $2.00; Xerox $4.80. 92 pages.

THE DECISION AND SYNTHESIS PROBLEMS IN SEMI-MODULAR SWITCHING THEORY.

(L. C. Card No. Mic 59-4569)

James Harold Shelly, Ph.D.
University of Illinois, 1959

This paper is based on a theoretical investigation of two problems in the theory of semi-modular switching circuits. These problems are those of deciding whether there is some semi-modular circuit corresponding to a given specification, and of constructing such a circuit. The problem specification is assumed to be a set L of n-dimensional vectors whose components are non-negative integers, such that the corresponding circuit has L as its C-state lattice. (The C-state lattice is the set of component-wise lengths of sequences of states x(i) of a semi-modular circuit. These sequences have the property that for x(i) in the sequence, x(i+1) is a possible choice for the next state of the circuit.)

Two equivalence relations are defined for general sets of n-dimensional vectors whose components are arbitrary integers. The relation $\underline{a} \mathcal{S} \underline{b}$ is defined by $L(\underline{a}) = L(\underline{b})$, where $L(\underline{a}) = \{\underline{d} \mid \underline{d} + \bar{a} \in L \text{ and } \underline{d} \geq 0\}$. Let L be closed under the operation of taking the component-wise numerical maximum of any pair of elements of L, and let the number of equivalence classes of L under $\mathcal{S}$ (called $\mathcal{S}$-classes) be finite. Then any $\mathcal{S}$-class A determines a finite set $Q(\underline{A})$ of n-dimensional vectors whose components are non-negative integers. Any two elements $\underline{a}$ and $\underline{b}$ of some $\mathcal{S}$-class A such that $\underline{a} \leq \underline{b}$ may be related by an expression of the form $\underline{a} + \sum_i c_i\, q(i,\underline{A})$, where the summation index i ranges over the finite index set for the elements $q(i,\underline{A})$ of $Q(\underline{A})$. The coefficients c_i are non-negative integers. The jth component index is said to be spanned in A if for some $q(i,\underline{A})$ in $Q(\underline{A})$, $q_j(i,\underline{A}) \neq 0$.

Two elements a and b of L are defined to be in the same periodic class if the $\mathcal{S}$-classes which contain a and b have identical sets of indices which are not spanned, and $a_j = b_j$ whenever j is in the common set of unspanned indices. If B is a periodic class of L, then all $\mathcal{S}$-classes whose elements appear in B have identical Q's. This implies that the basis Q may be interpreted as a function of the periodic class as well as of the $\mathcal{S}$-class. It is shown that for each periodic class B of L, and for each $q(i,\underline{B})$ in $Q(\underline{B})$, then there exists a constant $\lambda(q(i,\underline{B}),\underline{B})$ dependent only upon B and $q(i,\underline{B})$, such that if a and b are in B and $|a_h - b_h| < q_h(i,\underline{B})$ for some h, then $|a_j - b_j| \leq \lambda(q(i,\underline{B}),\underline{B})\, q_j(i,\underline{B})$ for all j such that $q_j(i,\underline{B}) \neq 0$.

The principal result of the investigation is to show that the class of all C-state lattices of semi-modular circuits corresponds to the class of all sets L which have a finite number of $\mathcal{S}$-classes and have property I. Property I means that the vector whose components are all 0 is the least element of L, L is closed under the operation of taking component-wise numerical maxima, and that

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covering in L means a difference of 1 in some one component. This result solves the decision problem.

Although the proof of the decision problem yields a synthesis method, another theorem presents conditions necessary and sufficient that a given synthesis be valid.

Finally, the restriction that the problem specification be a lattice is weakened to permit the use of the set of join-irreducible elements instead. As an application of the theory, the class of semi-modular circuits which have delays in all lines is characterized.

Microfilm $2.00; Xerox $5.00. 99 pages.

THE EASIER WARING PROBLEM IN ALGEBRAIC NUMBER FIELDS.

(L. C. Card No. Mic 59-4574)

Rosemarie Margarete Gabriele Scheerer Stemmler, Ph.D.
University of Illinois, 1959

The Waring problem in algebraic number fields may be defined as follows. If K is an algebraic number field of degree n, $K^{(1)}, K^{(2)}, \ldots, K^{(n)}$ are the n conjugate fields, $K^{(j)}$ $(j = 1,2,\ldots,n_1)$ being real and $K^{(j)}, K^{(j+n_2)}$ $(j = n_1+1, \ldots, n_1+n_2)$ being conjugate complex, where $n_1 + 2n_2 = n$, we call a number ν of K totally positive if $\nu^{(j)} > 0$ $(j = 1,2,\ldots,n_1)$. Then K is totally complex if $n_1 = 0$, totally real if $n_2 = 0$. For any positive integer m let J_m be the ring generated by the m-th powers of the integers in K. Does there exist a least number s such that the equation

$$\nu = \lambda_1^m + \lambda_2^m + \ldots + \lambda_s^m$$

has an integral solution $\lambda_1, \lambda_2, \ldots, \lambda_s$ in K, where each λ_i is totally positive or zero $(i = 1,2,\ldots,s)$ for every totally positive number ν of J_m ? If so, what is this least number g(m;K) ? Siegel proved that g(m;K) exists if K is not totally real.

The easier Waring problem consists of finding the smallest number s, which we call v(m;K), such that every integer in J_m is representable in the form

$$\nu = \pm \lambda_1^m \pm \lambda_2^m \pm \ldots \pm \lambda_s^m$$

for some integers $\lambda_1, \lambda_2, \ldots, \lambda_s$ of K.

It is one of our results that if K is totally complex, the existence of v(m;K) implies the existence of g(m;K).

We show that v(m;K) has a finite upper bound for every m and every K. In particular, if m is prime, we find upper bounds independent of the field K:

$$v(2;K) = 3, \quad v(3;K) \leq 6, \quad v(5;K) \leq 10$$

$$v(q;K) \leq 2^{q-1} + 1 + (q-1)/\min_{p<q}(\mathrm{ord}_q p)$$

$$\leq 2^{q-1} + 1 + (q-1)3 \text{ if } q \text{ is a prime equal to or greater than 7, } \mathrm{ord}_q p \text{ being the multiplicative order of p modulo q, p a prime.}$$

When m is not a prime, our upper bounds for v(m;K) actually depend on the degree n of K:

$$v(m;K) \leq 2^{m-1} + n(2m-1) + 1 \text{ when m is odd.}$$

$$v(m;K) \leq 2^{m-1} + n(4m-1) + 1 \text{ when m is even.}$$

The method to obtain such results is the following. Given an identity of the form

$$\sum_{i=1}^{j} e_i(a_i x + b_i)^m = cx + d$$

for rational integers j, a_i, b_i $c \neq 0$ and $e_i = \pm 1 (i = 1,2,\ldots,j)$ for fixed m, we see that J_m consists of certain residue classes modulo c. If we define $\Delta(m,c)$ as the least value of s such that every residue class modulo c which belongs to J_m contains integers of the form $\pm \lambda_1^m \pm \ldots \pm \lambda_s^m$, where $\lambda_1, \lambda_2, \ldots, \lambda_s$ are integers in K, then

$$v(m:K) \leq j + \Delta(m,c)$$

For every m we have the identity

$$\sum_{i=0}^{m-1} (-1)^{m-1-i} \binom{m-1}{i} (x+i)^m = m!x + \tfrac{1}{2}(m-1)m!.$$

The main body of this paper concerns the determination of upper bounds for $\Delta(m,m!)$

If $m! = P_1^{t_1} P_2^{t_2} \ldots P_k^{t_k}$, where P_i is a prime ideal in K $(i = 1,2,\ldots,k)$, and there exist solutions $\lambda_1, \lambda_2, \ldots, \lambda_{ri}, \ldots, \lambda_{si}$ of the congruences

$$\nu \equiv \lambda_1^m + \lambda_2^m + \ldots + \lambda_{r_i}^m - \lambda_{r_i+1}^m - \ldots - \lambda_{s_i}^m \pmod{P_i^{t_i}} \quad (i=1,\ldots,k)$$

for every ν in J_m, then

$$\Delta(m,m!) \leq \max_{1\leq i\leq k} r_i + \max_{1\leq i\leq k}(s_i - r_i)$$

If $P_i^c \,||\, m$, then it suffices to let r_i and s_i be such that every number ν in J_m is congruent to a sum $\sum_{i=1}^{r_i} \lambda_i^m - \sum_{j=r_i+1}^{s_i} \lambda_j^m$ where $(\lambda_1, \lambda_2, \ldots \lambda_{r_i}, \ldots, \lambda_{s_i}, P_i) = 1$ for some integers $\lambda_1, \ldots, \lambda_{r_i}, \ldots, \lambda_{s_i}$ in K. Similarly, if p is a rational prime and $p^f \,||\, m$, let $w = f+1$ if p is odd, $w = f+2$ if $p = 2$. If every ν in J_m is congruent to an expression $\sum_{i=1}^{u} \lambda_i^m - \sum_{j=u+1}^{v} \lambda_j^m \pmod{p^w}$, where $(\lambda_1, \ldots, \lambda_u, \ldots, \lambda_v, p) = 1$ and $\lambda_1, \ldots, \lambda_u, \ldots, \lambda_v$ are integers of K, we may take $r_i = u$, $s_i = v$ whenever $P_i \mid p$, $1 \leq i \leq k$.

The overall bound $n(4m+1) + 1$ for $\Delta(m;m!)$ implies that the singular series in the generalization of Waring's problem to algebraic number fields[1] has a positive lower bound when the number of summands exceeds n(4m-1).

We also show that there exist algebraic number fields K such that $v(m;K) < v(m;R)$, where R is the rational number field; we prove that $v(4;R(\sqrt[4]{3})) \leq 8$, whereas it is known that $v(4;R) \geq 9$.

Microfilm $2.00; Xerox $3.00. 41 pages.

1. C. L. Siegel, Generalization of Waring's Problem to Algebraic Number Fields, Amer. J. Math., vol. 66 (1944).

THE STRUCTURE OF THREADS.

(L. C. Card No. Mic 59-4206)

Charles Robson Storey, Jr., Ph.D.
Tulane University, 1959

Chairman: A. H. Clifford

A thread, as defined by Professor A. H. Clifford, is a connected topological semigroup in which the topology is induced by an order relation. Previous results in the theory of such semigroups have completely described

A) all threads containing an identity and containing a zero as an endpoint,

B) all compact threads with an identity and a zero,

C) all compact threads with idempotent endpoints.

The purpose of this dissertation is to initiate the study of the structure of more general threads - the end result we envision, but do not establish, being the description of a process by which all threads could be constructed from the basic examples. The principal results established are the following.

If a maximal subgroup of a thread contains more than two elements, then it is iseomorphic either with the group of positive real numbers, or with the group of non-zero real numbers. The existence of such a group iseomorphic with the non-zero real numbers is sufficient to describe the structure of the entire thread.

The closed interval between any two idempotents in a thread is a subthread, which, falling in class C above, can be completely described.

The minimal ideal of a thread, if it exists, is either a group (in which case it is the whole thread), or consists of one-sided zeros. If a thread has no minimal ideal, then a zero may be adjoined as an endpoint - the result again being a thread.

The description of the threads in class A is extended to the class of all threads T, possessing a zero as an endpoint, in which $T^2 = T$.

If a thread S, for which $S^2 = S$, contains a proper minimal ideal, then either the elements larger, or those smaller, than the minimal ideal form a subthread T which has a zero as an endpoint and in which $T^2 = T$. Moreover, after taking the Rees quotient of the thread by its minimal ideal, the multiplication obeys a monotone condition essentially like that of the multiplicative thread of all real numbers.

If, in a non-compact thread S with a zero and with $S^2 = S$, the topological closure of the ideal generated by each cut point is compact, then the multiplication on S can be extended to the compact ordered space obtained by adjoining the necessary endpoints to S.

If a thread S, in which $S^2 = S$, contains at most one idempotent which is a cut point, then the structure of S can be completely described.

These results indicate that the hypothesis "$S^2 = S$" is a fairly effective substitute for those dealing with the existence of idempotents in the three classes listed above. Moreover, it is seen that the assumption of compactness can, to a large extent, be avoided.

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ASYMPTOTIC BEHAVIOR AND STABILITY FOR SYSTEMS OF NONLINEAR DIFFERENTIAL EQUATIONS.

(L. C. Card No. Mic 59-4181)

William Edward Thompson, Ph.D.
Purdue University, 1959

Major Professor: Lamberto Cesari

In §1 of this thesis we consider systems of n first order differential equations of the form $y' = Q(y)$ for which there is known to exist a periodic solution $y = y^*(t + \gamma)$ defining a simple closed orbit in the n-dimensional phase space. It is proved that under fairly general conditions the question of the orbital stability, or asymptotic orbital stability, of this solution can be reduced to the question of stability in the sense of Lyapunov or asymptotic stability, respectively, of the identically zero solution of a new system of n - 1 first order equations.

In §2 theorems are obtained which furnish criteria for the orbital stability of solutions of systems of first and second order equations containing a small parameter of the form investigated by L. Cesari, J. K. Hale, R. A. Gambill and W. R. Fuller.

In §3 it is proved that the method of the first approximation of Kryloff and Bogoliuboff for the quasi-linear second order equation $\ddot{x} + \sigma^2 x = \varepsilon q(x, \dot{x}; \varepsilon)$ can be established in a rigorous form in the case of a solution which these authors call a stable stationary solution. In addition it is shown that the condition that $q(x, \dot{x}; \varepsilon)$ be a polynomial in x, $\dot{x}$ can be generalized to include the case where $q(x, \dot{x}; \varepsilon)$ is analytic in x, $\dot{x}$ with essentially the same results.

Finally it is proved that the method of the first approximation of Kryloff and Bogoliuboff can be extended to certain systems of n first and second order equations with essentially no change in the formal procedure.

In §4 the second method of Lyapunov is applied along with the method of §1 to obtain additional criteria for orbital stability of known periodic solutions for systems of the type considered in §1.

In §5 we consider real autonomous systems of n equations having the form $y' = Q(y)$ for which there is known to exist a two parameter family of periodic solutions defining a two dimensional periodic surface in the n-dimensional phase space. We then define a type of orbital stability for periodic surfaces analogous to that for a periodic orbit.

It is shown that if a certain Jacobian is different from zero, then by a convenient change of coordinates the question of the orbital stability (asymptotic orbital stability) of the periodic surface can be reduced to the question of the stability in the sense of Lyapunov (asymptotic stability) of the identically zero solution of a system of n - 2 equations in the new coordinates. Then by investigating the new system a series of theorems are proved which furnish rather general criteria for the orbital stability of the periodic surface.

Microfilm $2.15; Xerox $7.60. 161 pages.

SOME CONTRIBUTIONS TO THE SOLUTION OF SOME STATISTICAL PROBLEMS IN THE EXTERIOR BALLISTICS OF SPIN-STABILIZED ROCKETS.

(L. C. Card No. Mic 59-4697)

William Tunstall Wells, Ph.D.
North Carolina State College, 1959

Supervisors: Richard Loree Anderson
and John W. Cell

This dissertation has been concerned with the development of a method for examining and describing the effects of random variation in the solution of the differential equations of motion of a spin-stabilized rocket. In addition to the sources of dispersion that are usually considered, some variation has been assumed in two additional variates which are related to the launch velocity and the burnt velocity.

The first problem was to find the bivariate density function of the real and imaginary parts (or of the magnitude and direction) of a complex quantity which is a complicated function of real random variables. It was initially assumed that these random variables were normally distributed. The maps of the bivariate normal equi-density ellipses into the complex plane were obtained and examined. Sample data for two types of rockets were used to indicate the computations involved. This did not lead to a successful determination of the bivariate density function, but did lead to a method of examining the effect of the random variables on the complex quantity; also this approach yielded some restrictions on permissible mathematical models for the statistical study. It is permissible for purposes of partitioning the total dispersion to assume that the complex quantity has a circular normal distribution.

The second basic problem was that of finding the probability density function of the product of two complex random variables each of which has a circular normal distribution. The quantity of prime interest was the probability that the product of the two complex variates was contained in a circle of a given radius. Two approaches to the problem yielded the distribution of the product of two χ^2 variates and also the distribution of the product of a Rayleigh variate multiplied by a non-central Rayleigh variate. The first of these was obtained by use of Mellin transforms and the other product distribution by direct integration, making use of tabulated Laplace transforms. One approach is computationally simple and gives an approximate answer; the other is more difficult to evaluate numerically but gives a more accurate result.

The final analysis of the possible allocation of permissible errors is of necessity an iterative type. The use of the methods derived here provides a means of making a careful study of any particular rocket and leads to the assignment of tolerances to the several random variables involved. Microfilm $2.00; Xerox $4.60. 88 pages.

SAMPLING INSPECTION WITH A GIVEN DISCRIMINATING POWER.

(L. C. Card No. Mic 59-4191)

William John Zimmer, Ph.D.
Purdue University, 1959

Major Professor: Irving W. Burr

Sampling inspection provides a rule for decisions concerning the quality of a lot or process of a manufactured product: acceptance if the quality is "good" and rejection if not. The probability of acceptance of a lot of any given quality can be found and such probabilities determine the protection provided by sampling inspection plans against (a) the rejection of "good" lots and (b) the acceptance of "bad" lots. Most current plans have taken other approaches than direct discrimination between "good" and "bad" lots. It is here proposed to develop plans based on a given discriminating power such that the decisions are based on a minimum average sample number.

For attribute sampling, the manner of developing such plans is dependent on the method of sampling that is employed. In each case, however, when Poisson probabilities are assumed, this development is aided by the use of a concept of relative discrimination, the Operating Ratio defined by:

$$R_0 = p'_2/p'_1,$$

where p'_1 and p'_2 are the respective fraction defectives of quality of "good" and "bad" lots. The use of R_0 permits the development of a more general sampling inspection plan.

Even in single sampling, the sample number can be decreased by allowing tolerance limits on the discriminating power. The decrease in sample size is quite significant in some cases since the acceptance criteria, the number of defectives in a sample, are necessarily integers. Individual plans are computed for a useful range of p'_1 and p'_2 values and further, a table based on R_0 is presented. The computation of these tables and those following was performed by a routine developed for the Datatron, Purdue's electronic computer.

Since the underlying distribution of defectives is assumed to be Poisson, the effect on the plans of this assumption when the binomial or hypergeometric distribution is actually more realistic is investigated and the maximum differences in the probabilities of acceptance for a range of c values are tabulated.

The effect on the plans of truncation and inspector inefficiency is also discussed.

The development of optimal plans for double sampling is more difficult due to the larger number of parameters on which a plan is based. It is conjectured that for plans which give a minimum ASN at p'_1, the acceptance numbers are related as follows:

$$\left(c_3 + \frac{1}{2}\right) \doteq \frac{n_1+n_2}{n_1}\left(\frac{c_2!}{c_1!}\right)^{\frac{1}{c_2-c_1}}.$$

This conjecture is based on the analogy of double sampling to the sequential probability ratio test and is substantiated empirically by plans developed by means of a computer

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routine. Plans are developed for the ratio of sample numbers:

$$\frac{n_2}{n_1} = 1 ,$$

and the effect of other ratios on the ASN is investigated, the above proving to be highly satisfactory, for common protection requirements.

Methods for obtaining a lower ASN for existing plans while ensuring essentially the same protection are also discussed.

In variables sampling, most existing plans are based on the assumption that the underlying distribution of measurements is of the normal type. Little is known about the effect of this assumption if the distribution is otherwise. Using a distribution developed by Burr, from which a family of distributions for various levels of skewness and elongation can be obtained, it is shown that a smaller sample could actually give the same protection if the distribution is skewed toward the specification against which the plan protects. This result is obtained for single sampling.

Through the use of a Monte Carlo technique and a simulated sequential test run on the electronic computer the same conclusion is reached in the case of sequential sampling for variables.

Microfilm $2.95; Xerox $10.20. 226 pages.

MINERALOGY

AN INVESTIGATION OF REACTIONS INVOLVED IN THE PREPARATION OF FERRITES.

(L. C. Card No. Mic 59-4931)

Clinton Frank Jefferson, Ph.D.
University of Michigan, 1959

The use of ferrites in electrical circuits has become of increasing importance in recent years. The purpose of this study is to investigate some of the solid state reactions involved in the preparation of such ferrites. In some instances, a correlation between the physical and chemical properties and the magnetic properties is made. The emphasis, however is placed on the investigation of physical and chemical changes resulting from the solid state reactions.

The phase relationships, kinetics of the ferrite formation in several different atmospheres, and the densification process were studied in the systems (Ni,Zn)O-Fe_2O_3 and Li_2O-Fe_2O_3 by means of chemical analysis, microscopic examination of polished sections, X-ray analysis, density measurements, and measurements of such magnetic properties as the Curie temperatures and saturation moment. By differential thermal analysis, chemical analysis, and saturation moment measurements, the progression of the oxidation of the systems $Ni_{.474}Zn_{.526}Fe_2O_4$-$Fe_3O_4$ and $LiFe_5O_8$-Fe_3O_4 was followed.

The phase diagrams for the systems $Ni_{.474}Zn_{.526}Fe_2O_4$-$FeOFe_2O_3$ and $LiFeO_2$-FeO-Fe_2O_3 in air at one atmosphere were determined using the quenching technique. The composition of magnetite in solid solution with $Ni_{.474}Zn_{.526}Fe_2O_4$ and with $LiFe_5O_8$ in the ferrite-hematite field is $7Fe_3O_4$-$3Fe_2O_3$. Stoichiometric lithium ferrite, $LiFe_5O_8$, decomposes at around 1000°C, with the formation of $LiFeO_2 \cdot xFeO$ and $LiFe_5O_8 \cdot xFe_3O_4$.

The reaction between the constituent components to form the ferrite phase was investigated by two methods. A microscopic study of the reaction between NiO and Fe_2O_3 shows that both oxides take part in the diffusion process. The kinetics of the reactions between NiO and Fe_2O_3 and between Li_2CO_3 and Fe_2O_3 were investigated in air, oxygen and nitrogen by measuring the change in the magnetic moment with reaction time. The data for the reaction between NiO and Fe_2O_3 in a nitrogen atmosphere fit Jander's equation better than the data for the same reaction in air and oxygen atmospheres. The rate of reaction in a nitrogen atmosphere is greater than it is in air or oxygen atmospheres. The rate of reaction in an air atmosphere is slightly greater than it is in an oxygen atmosphere. The data for the reaction between Li_2CO_3 and Fe_2O_3 in air and oxygen atmospheres do not fit Jander's equation. The data for the same reaction in a nitrogen atmosphere, however, do fit Jander's equation. The rate of reaction in a nitrogen atmosphere is again considerably greater than it is in an air or oxygen atmosphere, and the rate of reaction in an air atmosphere is slightly greater than in oxygen atmosphere. Since Jander's equation assumes that the rate-determining step is the diffusion of the reacting components through the product layer, it is concluded that this is more nearly the case in a nitrogen atmosphere than it is in an air or oxygen atmosphere. In an air or oxygen atmosphere, the reaction at the boundary plays a role in determining the rate of reaction.

In general it is found that the ferrite formation is completed before the densification becomes pronounced. The extent of densification during sintering at a constant temperature is related to the green density, g, of the compact by the equation $\Delta D = -f_1(T)g + f_2(T)$, where ΔD is the change in density and f_1 and f_2 are functions of the reaction temperature. The permeability is found to be closely correlated with the percent of densification.

The presence of $Ni_{.474}Zn_{.526}Fe_2O_4$ and $LiFe_5O_8$ in solid solution with magnetite stabilizes γFe_2O_3 formed during the oxidation process. The temperature to which γFe_2O_3 is stabilized depends on the concentration of the stabilizing ferrite and the particle size of the sample. $Ni_{.474}Zn_{.526}Fe_2O_4$ and $LiFe_5O_8$ are equal in their stabilizing effect. From measurements of the saturation moment as a function of the percent of oxidation, it is concluded that, in the initial stages of the oxidation of magnetite, γFe_2O_3 is formed. Microfilm $2.00; Xerox $6.00. 123 pages.

A STUDY OF THE QUALIFICATIONS AND EXPERIENCES IN MUSIC OF ELEMENTARY CLASSROOM TEACHERS IN THE PUBLIC SCHOOLS OF OREGON.

(L. C. Card No. Mic 59-4308)

Justin LeRoy Dyrud, Ed.D.
University of Oregon, 1959

Adviser: Robert E. Nye

The concept of the self-contained classroom has been a subject of controversy throughout the United States in recent years. Much of the discussion has centered around the teaching of elementary classroom music; whether it should be taught by the classroom teacher or by the music specialist. A corollary of this controversy is the evaluation of the competencies and qualifications in music education of the elementary classroom teacher.

This investigation into the qualifications and backgrounds in music of elementary classroom teachers was provoked by the lack of information concerning the results of college music education courses and attitudes and practices in elementary classroom music in Oregon public schools.

The most practical means of obtaining such information was believed to be a questionnaire survey gathering data from teachers of elementary classroom music. This questionnaire was based upon criteria derived from information submitted by Music Educators National Conference officials in response to a letter of inquiry concerning opinions as to necessary qualifications for the teaching of elementary classroom music, conferences with educators, and pertinent related research. The questionnaire was sent to 400 elementary classroom teachers of music in Oregon public schools who were chosen by means of alternate selection from the county school directories of Oregon; the return was slightly more than 53 per cent.

The conclusions derived from analysis of the data obtained from the two major populations of this study may be summarized as follows:

1. Professional music educators and elementary classroom teachers are in general agreement concerning the qualifications for teaching elementary classroom music.
2. Music educators find no need for adding pre-student teaching classroom experiences in conjunction with college methods courses.
3. Generally speaking, most classroom teachers need more music education than they now possess in order to teach elementary music satisfactorily. Specifically there is a need for additional competencies in singing, rhythmic responses, corrective teaching methods, knowledge of teaching for appreciation and creativity, and related classroom experiences. A majority of the out-of-state-educated teachers lack education in music fundamentals.
4. Practice in Oregon elementary schools does not bear out the concept that music is a balanced program embracing the five areas of music education.
5. Oregon-educated teachers are slightly better qualified than out-of-state-educated teachers in most phases of music education.
6. The major criticism of music education course content is that it is overly theoretical and not sufficiently practical.
7. The question of who, the classroom teacher or the music specialist, can best carry on the elementary classroom music program remains undecided.
8. The majority of elementary classroom teachers are satisfied with the basic nine hour music education sequence currently required for graduation by Oregon state institutions offering degree programs in elementary teacher education. However, a sizeable minority, (25%) desire the number of hours of music required increased from fifteen to twenty-two hours.
9. The majority of elementary teachers find the teaching of classroom music enjoyable.
10. It is almost unanimously agreed that music has positive social and moral values in the life of the child.

The study includes a final section devoted to suggested ways of remedying the deficiencies in Oregon elementary school music education which were identified in the study.

Microfilm $2.10; Xerox $7.40. 159 pages.

A HISTORY OF MUSIC EDUCATION IN THE SAN FRANCISCO PUBLIC SCHOOLS.

(L. C. Card No. Mic 59-3517)

Robert M. Fowells, D.M.A.
University of Southern California, 1959

Chairman: Professor Rush

It was the purpose of this study to trace the changing philosophies and techniques of public school music in the San Francisco City Schools and to write a chronicle of the efforts and accomplishments of those in charge of its instruction.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

Within twenty years after the discovery of gold in 1848, San Francisco had changed from a Spanish outpost to a thriving city of Americans, Asiatics, and Europeans. The first free schools opened in 1849 and 1850, and the early teachers—John Pelton, John Swett, T. J. Nevins, and James Denman, all from New England—taught music from the writings of Lowell Mason. An essential part of the curriculum from the very beginning, music was used to entice volunteer students into the classroom, to raise morale, to begin the process of cultural polish, and to instill patriotism in the foreign-born.

In 1859 F. K. Mitchell was appointed a special music teacher by the board of education. He was succeeded ten years later by Washington Elliott, under whose leadership the departmental staff grew to a total of seven members. Luther Whiting Mason's National Music Course was used as the approved text, and instruction in the classroom was largely theoretical. In 1880 the music department staff was wiped out with the exception of Marie Withrow, who was charged with the direction of classroom instruction. After she left for Europe in 1883, music progressively died out of the schools because of apathy on the part of the classroom teachers.

Regular instruction was resumed in 1897 when Estelle Carpenter became supervisor of music, a position which she held until 1945. A dedicated and indefatigable worker, she endeared herself to the city through her massed choruses and her relief work following the disaster of 1906. Her tenure saw the beginning of record listening, children's concerts, and the activity approach to classroom music. Accredited high school vocal music was instituted in 1910 through the interest of the superintendent, Alfred Roncovieri, a professional musician who also trained the first all-city high school orchestra himself. High school instrumental music began in 1916 when an orchestra was organized at Polytechnic High School by Charles Lamp, who later served as supervisor of secondary instrumental music. Two junior high schools were started in 1925, and each offered both vocal and instrumental music.

A new era began in 1934 when Edwin A. Lee, also an active musician, was appointed to the superintendency in an effort to restore faculty morale, which was badly shaken by inbreeding and the depression. One of his first appointments was Charles M. Dennis, dean of music at the College of the Pacific, who became Director of Music. Under Dennis' direction a system of in-service development for elementary instruction was begun, high school a cappella choruses were encouraged, instrumental instruction was extended to the elementary schools, a music major was provided in the high school curriculum, student operas and concerts were expanded, and relations with professional musicians were improved. Upon Dennis' retirement in 1955, Dr. Karl Ernst, formerly supervisor of music in the Portland schools and for one year head of the Music Department at San Jose State College, was named Director of Music.

The evolution of school music in the San Francisco City Schools provides forceful evidence that music education can flourish only in the presence of interested administrators, vital teaching, and appealing music. At one period it all but died out when technical training overshadowed subjective enjoyment. However, irrespective of instructional emphasis, music has been offered continuously in San Francisco because it contributed to refinement, emotional control, physical development, patriotic expression, and elevation of the spirit.

Microfilm $3.45; Xerox $11.80. 267 pages.

A HISTORY OF MUSIC EDUCATION IN SEVENTH-DAY ADVENTIST WESTERN COLLEGES.

(L. C. Card No. Mic 59-3520)

Melvin S. Hill, D.M.A.
University of Southern California, 1959

Chairman: Professor Rush

It was the purpose of this study to investigate the historical aspects of the development of Music Education in the Western liberal arts colleges of the Seventh-day Adventist denomination. There was found to be similarly slow but unmistakably regular growth in the colleges examined. The philosophical purposes of the music departments of the three colleges were found to have great similitude and can be designated as follows: (1) to provide all students who are taking general college work with an opportunity to understand and appreciate music as a part of a liberal education; (2) to provide for those who plan to use music in connection with ministerial and Bible work; (3) to provide for those who desire to choose music as a vocation in life; (4) to adequately furnish the college, the community, and the constituency, insofar as is possible, with good music of a high caliber of performance; (5) to endeavor to make music serve a holy purpose, to lift the thoughts to that which is pure, noble, and elevating, and to awaken in the soul devotion and gratitude to God.

The history of Music Education in the three Western colleges was traced from the time of the founding of Pacific Union College in 1881, adding Walla Walla College, which began in 1892, and including La Sierra College, which commenced operation in 1922, to the present day. Many factors were inspected and considered, including general background history of the college, the history of various musical organizations, and growth of courses offered in Music Education and related subjects in each of these three colleges. Outstanding characters who gave impetus to or who retarded this growth and events of importance were given special mention.

Difficulties in continuing a progressive program of Music Education in a parochial college were explored, and tentative solutions to those problems were tendered.

It became apparent that the Music Education curriculum had increased with general college growth and that it was frequently many years behind the college growth; hence solutions for these problems were offered. Many salient and interesting facts were uncovered, from which insight was gained, trends were discovered, and long-range plans were made to utilize teaching staffs and physical plants of each college to better advantage.

The music departments have at present the finest printed curricula in their histories. By using a system of scholarship, serviceship, and salesmanship, these departments could grow in student enrollment and teacher effectiveness equal to those in any college of proportionate size in the United States.

Recommendations. In conclusion, factors recommended were (1) more definite and logical long-range planning, with each department anticipating its needs; (2) a system of student scholarships and serviceships which would aid the growth and increase interest in the departments; (3) more advanced training of the faculty members of each department in recognized schools of the National Association of Schools of Music, with adequate financial assistance; (4) a firm endeavor to aid teacher tenure with adequate physical teaching facilities, reduction of the notoriously high teaching load, and more attractive salaries; (5) an attractive and functional physical teaching plant with adequate studio room, rehearsal and practice rooms, and periphery space; (6) a resolution of many pressing financial problems with an adequate, available budget.

These six recommendations, in addition to a whole-hearted cooperation between music faculty members, the total backing of the administration, and a personal interest in every student, would precipitate a phenomenal growth unequaled in the history of Seventh-day Adventist college music departments.

Microfilm $4.05; Xerox $13.60. 314 pages.

THE USE OF CHARACTER NOTES AND OTHER UNORTHODOX NOTATIONS IN TEACHING THE READING OF MUSIC IN NORTHERN UNITED STATES DURING THE NINETEENTH CENTURY.

(L. C. Card No. Mic 59-4951)

Earl Oliver Loessel, Ed.D.
University of Michigan, 1959

The purpose of this study is to determine the extent of the use and influence of character and other unorthodox notations in northern United States during the nineteenth century. Much secondary source material is available on the use of these notations, especially character notation, in the south, but very little information is included on their use in the north.

This study consists of two main divisions: (1) the eight chapters which form the main body of the work, and (2) the annotated bibliography of 109 different books, and a total of 145 editions.

The eight chapters are based chiefly on the introductions, prefaces, and other introductory material in the books, with the music itself treated briefly. After an introductory chapter, the work is divided according to types of notations as follows: four-character, which was the beginning of an unbroken line of unorthodox notation, and the most popular; seven-character, the most perfect for singing of all unorthodox notations; and numeral, Hood's, and other less important reform notations. The reasons for the decline and almost complete extinction of all unorthodox notations with a brief mention of contemporary variations in notation conclude the work. Interspersed throughout the main body of the work are eighty-six plates used to illustrate the text and eleven tables listing the types of notations chronologically.

The bibliography of tune and hymn books includes the complete title (with indications of typography) of every nineteenth-century book discussed in this study. Two eighteenth-century books also are included. Total number of pages, cover sizes, location symbols, comparison of cover and title-pages, scale of F major in notation used in the work, and content are given for each book. Contents of succeeding editions are listed only when a change occurs. In addition to this, there is a bibliography of secondary materials.

Books in unorthodox notations were far more popular in the north during the nineteenth century than most historians state. These notations developed as a result of singing school teachers' constant search for improvement in instructional methods. The usage of all these "helps to read" followed the pattern of migration and went from north to south and west, which was a movement from urban to rural areas, from a cultured to a more backward society. Many factors contributed to the decline and almost complete extinction of the use of unorthodox notations, but the establishment of vocal music education in the public schools and the use of regular notation by the teachers of these classes might be considered the deciding factor. The singing schools and tune-books which had promoted music instruction in the eighteenth and first part of the nineteenth century now were superseded by music instruction in the public schools and the graded series of vocal music instruction books.

Microfilm $7.25; Xerox $25.00. 571 pages.

RHYTHMIC FREEDOM IN THE PERFORMANCE OF FRENCH MUSIC FROM 1650 TO 1735.

(L. C. Card No. Mic 59-3719)

Newman Wilson Powell, Ph.D.
Stanford University, 1959

Most present-day performers assume that music of the seventeenth and eighteenth centuries should be performed strictly in time without any deviation from the literal written note values. Nevertheless, there are many explicit directions in theoretical treatises of the period, and occasionally in musical sources as well, that point to a tradition of rhythmic freedom in which the performer had the liberty and even the responsibility of departing from a strict and literal rendition of the rhythmic values. Even though this problem is quite an extensive one, it was considered advisable for the present study to center the attention on French practice from 1650 to 1735 because (1) this represents a comparatively unified style period that was self-contained and that was, at the same time, significant for future developments; and (2) the documentation of the practice of rhythmic freedom within this frame of reference is relatively complete and unequivocal.

In order to get an adequate picture of French practice from 1650 to 1735 it was necessary, however, to trace the manifestations of rhythmic freedom from early in the sixteenth century (with some references to even earlier practice) and to make some comparison between French practice and that of other national styles.

Rhythmic freedom as employed in the sixteenth to the eighteenth centuries may be classified into two main types: (1) "rhythmic alteration," in which individual notes in the melodic lines deviate from their written values, while the

basic rhythmic structure remains undisturbed; and (2) "tempo fluctuation," in which the beats themselves, and consequently the entire musical texture, are subject to manipulation.

The first of these types is described in the sixteenth century in connection with the technique of ornamentation known as diminution. It continues in the seventeenth and eighteenth centuries in the use of such rhythmic devices as the French notes inégales, the intensification of dotted rhythms (especially characteristic of the French overture and of certain dance rhythms), the so-called Lombardian rhythm or Scotch snap, and the Italian rubato as described by Tosi and others.

Tempo fluctuation is associated with certain kinds of pieces--e.g., Italian madrigals of the sixteenth and early seventeenth centuries; the vocal recitative, which had its beginnings around 1600; certain types of chansonettes; and fantasies, preludes, toccatas, and similar pieces for the lute or keyboard.

The unmeasured preludes of French baroque instrumental music present a special problem of rhythmic interpretation, since the rhythm here is not specified in the notation. Still another aspect of rhythmic freedom in this period is to be found in the performance of the French agréments, where the melodic pattern of notes is more or less explicit while the rhythm is left to the discretion of the performer.

In this study, the historical evidence for all of these types and manifestations of rhythmic freedom is examined in systematic and chronological order, and the practice of rhythmic freedom is related to the various styles and types of pieces of this period. The modern performer thus has a guide to the sort of rhythmic manipulation that is appropriate in various styles and kinds of pieces, and he is made acquainted with some of those aspects of rhythmic performance that are necessary to a reconstruction of the quality of movement characteristic of baroque music.

It was concluded that one of the outstanding features of the rhythm of baroque music is the admixture of irrational (i.e., non-proportional) and proportional rhythmic relationships. The regular, proportional rhythmic framework furnishes the listener with a sense of organization and control essential to a comprehension of the rhythmic structure, while the irrational, free element adds expressiveness, grace, charm, or elegance to the performance.

Microfilm $5.10; Xerox $17.00. 400 pages.

THE SONATAS FOR VIOLIN AND FIGURED BASS BY JEAN-MARIE LECLAIR L'AÎNÉ.

(L. C. Card No. Mic 59-4972)

Robert Elwyn Preston, Ph.D.
University of Michigan, 1959

This thesis constitutes a historical and stylistic study of the forty-eight sonatas for violin and figured bass of Jean-Marie Leclair l'aîné, a French violinist and composer who lived from 1697 to 1764. Leclair wrote four books of twelve sonatas each, dated 1723, 1728, 1734, and 1738.

The study is organized into three major divisions. The first contains a brief biographical chapter and a detailed, annotated description of the original editions of each book.

The second portion concerns performance practices, including separate sections on Leclair's highly personal method of notating accidentals and figured bass, and on the realization of his ornaments. The section discussing ornaments will be useful, especially to those performing the sonatas, since a specific study of ornaments as they apply to Leclair has never before been made.

The third portion contains a detailed analysis of each of the forty-eight sonatas, accompanied by numerous musical examples. At the end of each set of twelve sonatas, a brief summary gives the outstanding characteristics of the book and notes the changes in style occurring from one book to the next. The analyses reveal the evolution of Leclair's style, and several trends are quite clearly apparent.

In the expansion of violin technique, Leclair makes progressively greater demands on the performer, particularly with the inclusion of complex double stops. Another important trend, in Leclair's development as a composer, can be observed in his treatment of harmony. The early sonatas are conservative with respect to harmonic vocabulary, modulations, and chord progressions. However, the later sonatas show an increasing use of altered and chromatic chords, bolder and more remote modulations, and striking chord progressions which include many types of avoided cadences. Another aspect of Leclair's harmonic growth is illustrated by his gradual acceptance of bimodality in its fullest implications. In the last book of sonatas the harmonic and melodic materials of both modes are freely combined, alternated, and occasionally juxtaposed, creating a highly original harmonic texture. Although overlooked to a large extent by most writers, Leclair's ingenious and exciting treatment of harmony constitutes one of the most interesting findings of this thesis.

Chiefly because Leclair's music is so varied and diversified, it is exceedingly difficult to summarize or describe in a few words. No stereotyped idea concerning the content of the individual sonata movements is apparent. Within the usual four-movement plan of alternating slow and fast movements, a great variety of types and styles appears. Regarding melody, rhythm, and harmony also, Leclair is quite unpredictable; and even with respect to formal structure, the common bipartite form is treated in such a wide variety of ways that it cannot possibly be considered a mold or rigid framework.

Neither of the broad and rather general terms, "baroque" or "rococo," can be applied exclusively to the aggregate of Leclair's sonatas. There are movements with a monumentality, intensity, and strength which seem thoroughly baroque; yet other movements bespeak the light, ornamental, and delicate style of the rococo.

Along with Leclair's diversity of style, it must be admitted that his music is somewhat uneven in quality. In particular, some of the fast movements seem more contrived than inspired, more routine than exciting. However, the sonatas contain many movements of extraordinary beauty and expressiveness which earn for Leclair a place among the finest eighteenth-century composers of violin sonatas.

Microfilm $8.30; Xerox $28.40. 656 pages.

THE HISTORY OF BAPTIST HYMNODY IN ENGLAND FROM 1612 TO 1800.

(L. C. Card No. Mic 59-4408)

Robert H. Young, D.M.A.
University of Southern California, 1959

Chairman: Professor Hirt

Comparatively little research has been done in the field of Baptist hymnody. Works which have been published are, for the most part, concerned with biographical sketches of Baptist hymn writers. Several brief and concise histories have been prepared as articles or chapters incidental to larger works. Foremost among these is the article in the Julian Dictionary of Hymnology entitled "English Baptist Hymnody," which is factual but, of necessity, limited.

It is, then, the purpose of this dissertation to throw as much light as possible on aspects of English Baptist hymnody hitherto untouched. An attempt is made to discover (1) the attitudes of the founders concerning hymn singing and the influence of these attitudes on subsequent hymnic development within the denomination during the seventeenth and eighteenth centuries; (2) the hymnic materials, both texts and tunes, adopted by the Baptists from without the denomination; (3) the influence of Baptist hymnists, both within and without the denomination during the seventeenth and eighteenth centuries; (4) the continuing influence of their contribution in both England and America.

The negative attitudes of General Baptists toward congregational singing during the seventeenth and early eighteenth centuries originated with their founder, John Smyth (d. 1612). However, Smyth was not opposed to singing as such, for he considered it to be an ordinance of God. Rather, he was concerned with method and objected to more than one person at a time singing a Psalm or the use of precomposed meter, rhyme, and tune.

The Particular Baptists, having no direct connection with the General Baptists, were much more liberal at this point. It is quite certain that some congregations were singing Psalms in the early 1650's, and it is possible that these same churches had sung from their inception since, at most, they were only a few years old.

In the decade between 1690 and 1700 the question of congregational singing occasioned a bitter controversy among the Baptist churches of London. The practice of congregational singing had been gaining ground rapidly, causing the conservative forces to voice vigorous protest. The controversy centered around the writings of Isaac Marlow, who opposed the practice, and Benjamin Keach, who had introduced singing in his congregation as early as 1673. Most of the ministers sided with Keach, and by 1700 hymn singing had become firmly established among the English Baptists.

References quoted in the dissertation indicate that Baptist congregations during the seventeenth century drew hymnic materials from three outside sources: William Barton's Book of Psalms, John Patrick's Century of Psalms, and Joseph Boyse's Sacramental Hymns. It is also fairly certain that some congregations used the "Old Version" of Sternhold and Hopkins.

Evidence at hand suggests that Benjamin Keach rather than Isaac Watts was the first to introduce hymns of "human composure" into the regular worship of a church. Keach's congregation at Horselydown sang his hymns as early as 1673, and he published Spiritual Melody in 1691, sixteen years before Watts' Hymns and Spiritual Songs.

The survey of hymn tune usage in this study is applicable to Baptists and other English Protestant denominations alike. A comparative chart shows the fifteen hymn tunes most widely used in England during the seventeenth century. The hymn tune underwent considerable stylistic change in the eighteenth century. Largely due to the tremendous influence of Handel, tunes became imitative and highly florid.

The last half of the eighteenth century was the golden age of English Baptist hymn writers. Among the best were Anne Steele, Samuel Stennett, Benjamin Beddome, Samuel Medley, Robert Robinson, and John Fawcett. These and other lesser known authors produced a large body of hymnic material which continued to be influential throughout the nineteenth and twentieth centuries in all major English and American Protestant bodies.

Microfilm $3.25; Xerox $11.20. 252 pages.

PHARMACOLOGY

AN INVESTIGATION OF SOME PHARMACEUTICAL APPLICATIONS OF CERTAIN FATTY ACID ESTERS OF SUCROSE.

(L. C. Card No. Mic 59-4377)

Howard Hopkins, Ph.D.
The University of Nebraska, 1959

Adviser: LaVerne D. Small

A recent development in sucrochemistry has made available a new group of compounds known as the sugar esters of the higher fatty acids. These ester compounds consist of sucrose chemically combined with one of the fatty acids, such as stearic acid. More specifically, these substances are mono- and diacyl derivatives of sucrose where the acyl group contains from 12-18 carbon atoms in the aliphatic chain. These new substances are nonionic, surface-active materials. The claim that these compounds were tasteless and non-toxic, in contrast with hitherto available surfactants, was suggestive that these new compounds might be especially useful in the food and pharmaceutical industries as emulsifiers, solubilizers and dispersing agents. In pharmaceutical practice, these esters might (a) aid in overcoming some of the problems in the solubilization of flavoring materials and other

chemicals occurring in pharmaceutical products, (b) serve as emulsifying agents in preparing emulsions for oral and parenteral use, (c) provide the basis for the development of a vehicle or carrier for therapeutic agents.

This study was initiated to investigate the range of usefulness of certain of these compounds in the formulation and use of pharmaceutical products intended for oral administration. Two of these esters, sucrose monomyristate and sucrose dipalmitate, have been studied. The latter material was procured from a commercial source but the former was synthesized by the investigator. This synthesis led to the development of an improvement in the purification procedure which had been recommended. Sucrose monomyristate is a water-soluble substance whereas sucrose dipalmitate tends to be oil-soluble. Tests with the monoester show that it is not sufficiently hydrophilic to serve effectively as a solubilizer of volatile oils. It has been found that both of the esters are good emulsifying agents, capable of forming stable emulsions at low concentrations that do not appear to be adversely affected by moderate changes in pH. The monoester appears to be particularly suitable for preparing emulsions of liquid petrolatum.

The diester may be dispersed in hot syrups, yielding a gel-like product which could serve as a useful vehicle for a large number of therapeutic agents. This "gelled" vehicle could be flavored to meet a variety of requirements. Such a vehicle, while not limited to such application, could prove useful in formulating pediatric medications. A product, using this vehicle and packaged in a collapsible tube, should be very acceptable to child and parent.

These esters are reportedly utilized as food if administered orally to an animal. However, the monoesters apparently exhibit some toxicity if administered parenterally. This may result from the marked reduction in the surface tension produced by the monoesters. The intraperitoneal acute toxicity of sucrose monomyristate was determined for the rat. The LD_{50} was 579 mg./Kg.

Although the sucrose fatty acid esters may have what appears to be a rather limited range of usefulness, nevertheless, they do appear to be well-suited as emulsifying agents and for the preparation of inexpensive, flavorable, gel-like vehicles which might be suitable for many therapeutic agents.

Microfilm $2.00; Xerox $4.00. 74 pages.

THE MECHANISM OF SENSITIZATION OF THE HEART TO VENTRICULAR FIBRILLATION BY A SUBSTITUTED PROPIOPHENONE AND BY AMARIN.

(L. C. Card No. Mic 59-4963)

Joanne Iweita Moore, Ph.D.
University of Michigan, 1959

This investigation was initiated in an attempt to study experimentally the mechanism of genesis of ventricular fibrillation as induced by a substituted propiophenone and by an imidazole compound. These agents, alpha-phenoxy-alpha-dimethylaminomethyl propiophenone (Upjohn 0882) and amarin (2:4:5-triphenyldihydro imidazole) have proved to be interesting tools in providing clues in the underlying mechanisms and relationships which make possible ventricular fibrillation under a variety of circumstances.

These agents were studied in a variety of preparations which included the intact unanesthetized dog, the intact anesthetized dog, the open-chest preparation, and the heart-lung preparation.

Intravenous administration of 10 mg/kg of U-0882 or amarin in the unanesthetized dog produced ventricular fibrillation. These compounds are unique in that they not only set the stage for fibrillation by sensitizing the myocardium but also as a result of their central or reflex actions provide the stimulus necessary for the ultimate onset of fibrillation.

Intravenous administration of 10 mg/kg of U-0882 or 5 mg/kg of amarin alone in the anesthetized dog produced a transient depressor effect and a concomitant stimulation of respiration. The electrocardiogram and direct measurements show that U-0882 prolongs greatly the refractory period of the auricular and ventricular myocardium without appreciably depressing conduction. Amarin has similar properties on refractory periods but also markedly depresses A-V conduction. U-0882 possesses weak antimuscarinic properties while amarin lacks this action.

Five mg/kg of amarin or 10 mg/kg of U-0882 followed in 2 to 5 minutes by a subsequent injection of 2 to 4 ug/kg of epinephrine, levarterenol, or isoproterenol induces ventricular fibrillation. Fibrillation may also be produced by electrical stimulation of the right auricle, right ventricle, or the stellate ganglion following sensitization with U-0882 or amarin.

Amarin or U-0882 fibrillation is not prevented by dibenzyline, quinidine, procainamide, or hepatectomy, measures which protect against hydrocarbon-epinephrine fibrillation. Fibrillation from U-0882- or amarin-epinephrine is prevented by the previous administration of toxic doses or ouabain and the administration of 10 mg/kg of the dichloro analogue of isoproterenol (Lilly compound 20522).

Congeners of U-0882 possessing both a keto oxygen and a methyl substitution on the alpha carbon are capable of sensitizing the heart to fibrillation. If the keto oxygen is reduced to an alcoholic hydroxyl group or if the alpha methyl is replaced by hydrogen, the resulting compound is converted into one which produces profound cardiac failure.

U-0882 or amarin sensitization of the heart differs significantly from the sensitization produced by various hydrocarbons in the mechanism by which ventricular fibrillation is facilitated. Fibrillation induced by amarin or U-0882 usually results from a normal sinus beat, induced to discharge at accelerating rates, being delivered to an incompletely recovered ventricular myocardium while fibrillation induced by hydrocarbon results from premature ventricular contractions arising from ectopic foci.

The nature of the fibrillatory wave fronts observed after U-0882 or amarin sensitization appears to be related to a "circus movement". There is no evidence to indicate that repetitive, accelerating discharges from ectopic foci could account for the speed and regularity of these fibrillatory waves.

It is proposed that continuous, but slowed, conduction in relatively refractory tissue could explain the phenomenon of "circus movement" as the basis for ventricular fibrillation. Microfilm $2.00; Xerox $5.20. 103 pages.

G. F. STOUT'S PHILOSOPHY OF ANIMISM

(L. C. Card No. Mic 59-4051)

Peter Adam Angeles, Ph.D.
Columbia University, 1959

Stout's method is to unearth and substantiate the unconscious presuppositions implicit in our activity and language. There are several such pre-reflective insights into the nature of reality which are assumed in ordinary experiencing and which traditional analyses of common sense have discussed: the belief in an external world, in causal connection, in personal identity, in the existence of other selves, in freedom of the will. Animism is one of these attitudes of common experience which must be added to this list as affording a truth about the nature of things.

Animism is defined as the persistent tendency of human nature to find and attribute mind to nature in general and not only to individual minds such as those of men and animals. This tendency pervades not only common sense but the thought of the primitive savage, the child and even science. Common sense is animistic because of its tendency to project qualities of our self upon external things and situations. We find evidence of this animistic strain in our ordinary language and in our thought in such words as pressure, stress, strain, unity, identity. They imply a projection upon external events of feelings and qualities of our own inner self and mind derived from insight into our activity of thinking, willing, doing and undergoing. These animistic attributes imply something more than what external observation and scientific description in terms of succession or co-existence provide, and are assumed by common sense as existing as real inner imperceptible states or qualities of material objects. The source of knowledge of these active tendencies can only stem from our own inner life of mind and experiencing.

These animistic projections are not mere metaphors. They reveal the reason why a thing acts as it does. Ordinary experience is expressing a truth that nature is alive with active tendencies and imbued with mind and must so be interpreted to be concretely understood. If the animistic interpretation of nature is basically wrong then we make nonsense of a great deal of common sense language. Mind functioning in nature can only be known on the analogy with the function of our own minds. Although it can never be completely known by this means, there is sufficient resemblance and similarity between the active tendencies of nature and our own embodied self to warrant some knowledge of mind in nature. Our active tendencies are continuous with and are supplemented by the active tendencies of nature. Experience is pervaded with a feeling of incompleteness and dependence of our being. The success of our activity implies some kind of mind in nature so ordering things as to make possible a transaction between the self and nature.

There are three types of animism assumed by common sense: (1) causal animism, (2) teleological animism, and (3) aesthetic animism. Each finds a particular aspect of mind in nature corresponding respectively to will, thought, and feeling or life. Causal animism finds an initiative in things analogous to our will and interprets connected events with reference to the felt active tendencies of our experiencing. Teleological animism is the persistent tendency of common sense to see plan, design in nature--parts adapted to other parts in a whole working to fulfill the function of the whole. Common sense attributes this teleology to the operative presence of mind in nature. Aesthetic animism views nature as alive and feeling, and as possessing the attributes of beauty and the sublime which are the expressions of mind in nature.

Microfilm $2.05; Xerox $7.40. 156 pages.

INTUITIONISTIC CRITICISMS OF THE ETHICAL THEORIES OF BRADLEY AND GREEN.

(L. C. Card No. Mic 59-4877)

Amedio William Armenti, Ph.D.
University of Michigan, 1959

The purpose of this thesis is to examine the chief criticisms directed against the ethical theories of F. H. Bradley and T. H. Green by the Oxford-Cambridge Intuitionists and to show that for the most part these critics were mistaken.

The first chapter is devoted to a general survey of the ethical theories of Bradley and Green. The chapter has a threefold purpose: (1) to bring out the similarities and differences between the theories of Bradley and Green; (2) to state those claims which are most fundamental to the theories and (3) to indicate certain issues on which there was conflict in the thinking of both Bradley and Green. Where the sort of internal conflict mentioned under (3) exists, a choice is made in favor of the view which in the author's opinion is most consistent with the theory as a whole.

In the second chapter, an attempt is made to dispose of the contention made by Intuitionistic critics that the concept of the true self is ambiguous and can have no real significance for moral theory and that the self-realization theory, (especially on Green's interpretation) in the final analysis, identifies moral duties either with governmental decrees or with the de facto customs of mankind.

The third chapter deals with arguments intended to show that any theory which gives a subjectivist account of good, either by offering a definition of 'good' in terms of satisfaction or by maintaining that a common ground of good can be found in terms of satisfaction, must be false. The Intuitionists have not only argued that 'good' is indefinable but have contended further that good is only contingently related to feelings and attitudes. All theories

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

which regard the relation between goodness and some state of mind (like satisfaction) as a necessary one, according to the Intuitionists, are compelled to deny both the objectivity of goodness and the intrinsic character of good. The point of this chapter is to show that the Idealistic theory does not take 'good' to be definable in the sense of definition employed by the critics and that, while it is a subjectivist theory, it need not deny the objective or 'intrinsic' character of good in any sense consistent with our ordinary beliefs about goodness.

The fourth chapter is concerned with problems relating to the nature and ground of obligation in the ethical theories of Bradley and Green. Deontological Intuitionists have argued that all theories which base obligation on the intrinsic or extrinsic goodness of actions fail to offer a genuine theory of obligation. One of the chief supports for this claim is Prichard's argument that any attempt to base obligation on the goodness of the action or its consequences resolves the moral 'ought' into the non-moral 'ought.' Since the Idealists do believe that right actions are those which are either good in themselves or promote the ultimate good, it is necessary to show that Prichard is mistaken. Reasons are offered in this chapter for thinking that he is mistaken. A further attempt is made to clarify the nature and epistemological status of 'ought' judgments in the theories of Bradley and Green.

In the final chapter a critical appraisal is made of some attempts by certain followers of Bradley and Green to modify and revise their theories in the light of the criticisms from the Oxford-Cambridge Intuitionists. The chapter deals with the work of two of the most prominent exponents of ethical Idealism in contemporary philosophy, C. A. Campbell and H. J. Paton. It is concluded that in large part both are justified in rejecting certain objectionable metaphysical features of the ethical theories of Bradley and Green, and that Paton in particular provides a statement of the self-realization theory more in line with our common sense notions of morality.

Microfilm $3.45; Xerox $11.80. 266 pages.

THE PHILOSOPHY OF FRANCIS ELLINGWOOD ABBOT.

(L. C. Card No. Mic 58-3215)

William Jerome Callaghan, Ph.D.
Columbia University, 1958

Francis E. Abbot (1836-1903) is best known now as a friend of C. S. Peirce and as a member of the Cambridge Metaphysical society. His contemporaries knew him as a religious reformer, too radical for a pulpit or a college teaching post, member of the Free Religion Association, editor of The Index, Colonel Bob Ingersoll's running-mate on the Liberal League's presidential ticket of 1880. But the reformer remained always a philosopher, reflected always a set of philosophic commitments, and worked steadily to fit those commitments within a coherent metaphysical system. This study concerns itself with these efforts and their results.

Abbot begins with a thorough-going acceptance of the methods of science. Insisting that these methods are the only valid ones, Abbot arrived at a "scientific theology" which sanctioned few of the beliefs of traditional religionists. He also rejected all philosophies which found a different basis for knowledge.

The belief that science had made genuine discoveries involved, for Abbot, certain positive consequences. One was that things-in-themselves could be and were known. Further, scientific laws reported relations to be exemplified in the physical world. That is, universals were "objective", much as the scholastic realists had maintained. Correcting their views, Abbot developed a theory of universalia inter res. Universals (and universal concepts) are relational structures. Thus conceptual knowledge of any object in nature consists in a more or less adequate reproduction of its "immanent relational constitution". (Abbot approximates Peirce's "fallibilism" in claiming that such knowledge never attains precision and completeness.) Some branches of knowledge (e.g. logic and mathematics) yield laws governing the valid use of highly general relational predicates. These laws are a priori -- in the interesting sense that all more specialized disciplines presuppose them.

A convinced evolutionist, Abbot demanded evolutionary explanations for every sort of existent. This, he argued, demanded the rejection of mechanistic materialism in favor of some kind of vitalism. He soon dropped all dualistic reservations to outline a thorough-going "organicism": the universe was itself an organism; and evolving God existed as the intelligence permeating the universe's course of development. Earlier, he had insisted on the "oneness of nature in God and man". That "oneness" reappears in the later explanations of the "universal intelligibility of nature". The route was different, but Abbot was coming always closer to an "objective logic" of the Hegelian variety.

The formalized style of Abbot's final work tends to disguise its continuity with his earlier productions. But it soon appears that Abbot is using a new and awkward idiom to expand on his earlier views, especially those on perception. Experience and reason are identical (or "interpenetrate") in the sense that all consciousness is of "percept-concepts"; there is neither "pure cognition" nor "bare sensation" but only the apprehension of some "object" as a specimen of a universal.

First arguing for the principle that "Whatever is evolved must have already been involved," Abbot then projects on nature generally the features he found characteristic of conscious experience. Thus an existent object, known (or knowable) through a percept-concept, is a "unit-universal", an "indissolubly unique knot of particular cases of innumerable universals in space and time." Speaking more substantially, existing individuals represent evolving patterns of energies. Some complicated patterns identify "minded" individuals. Among these must be included the universe taken as a unit. "The world itself is at bottom mind, syllogizing eternally".

The Syllogistic Philosophy includes surprisingly few ethical or theological arguments. Of these perhaps the most interesting maintain the need for a socially based ethics in which ethical obligation appears as the "perception of the objective necessity of the good as the obligatory better." Microfilm $4.25; Xerox $14.20. 329 pages.

G. E. MOORE'S REFUTATION OF BERKELEY'S IDEALISM.

(L. C. Card No. Mic 59-4371)

James D. Carney, Ph.D.
The University of Nebraska, 1959

Adviser: Oets K. Bouwsma

G. E. Moore in 1939 gave what he called a "proof for the existence of external things." This proof was intended to prove false Berkeley's statement that houses, mountains, rivers, in short, sensible objects do not exist unperceived. In his 1910-11 lectures, Moore argued that if Berkeley's statement is true, then Berkeley must believe certain things which "contradict" what he "cannot help believing in ordinary life." Are these two refutations successful?

The 1939 proof consists in Moore's gesturing with his two hands. Does this show that Berkeley's statement is false? No. For on examining Berkeley's explanation for his assertion we find that he conceives of houses, etc. as combinations of sensations. Consequently his saying that sensible objects do not exist unperceived is like saying that a pain does not exist unfelt. And holding up one's hands could not prove such an assertion false. For it makes no sense to speak of refuting such an assertion. If one is to meet Berkeley's assertion, then one must uncover those confusions of language which led Berkeley to conceive of houses, etc. as combinations of sensations.

Moore thinks he has proved Berkeley's assertion false because he thinks that Berkeley in making his assertion is denying the existence of hands. And we can see why he thinks this. Berkeley is denying that we perceive anything which can exist unperceived. Now Moore thinks that hands are things which we perceive and which can exist unperceived. Thus Moore thinks that Berkeley is denying that there are hands.

Moore's criticism that Berkeley holds a view which contradicts what he believes is directed against a proposition upon which Berkeley's assertion is based, namely: "Shapes or shaped things cannot exist unperceived." Moore argues that if Berkeley believes this to be true, then he must hold, for example, that when he is riding in a train coach, the wheels do not exist, since wheels are shaped things and no one is perceiving them. And if the wheels do not exist, they must have been destroyed, and, consequently, the coach is not supported by anything. Since, as Moore goes on to argue, Berkeley believes that the coach is supported, he believes that which contradicts his philosophical assertion. But Berkeley is not open to this criticism since he maintains that God is always apprehending the wheels. Furthermore, even if Berkeley had not maintained that God apprehends the wheels, he would not be open to this criticism. For if he said that the wheels do not exist while he is riding in his coach, he would not mean that they have been destroyed, but, rather, that no one is having those combinations of sensations called "wheels."

Moore thinks that Berkeley would be denying what he knows to be true if he said that the wheels do not exist while he is riding on a train. And we can see why he thinks this. Moore reacts to Berkeley's saying that the wheels do not exist as though Berkeley were reporting the wheels destroyed or something comparable.

Thus it can be concluded that although we can understand how Moore came to give a proof and make the charge of inconsistency, Berkeley's assertion cannot be so refuted and Berkeley is not guilty of such an inconsistency. Microfilm $2.00; Xerox $6.20. 127 pages.

VALUE AND INDIVIDUALITY: AN INQUIRY INTO THE WORTH OF THE HUMAN PERSON.

(L. C. Card No. Mic 59-3530)

John William Davis, Ph.D.
Emory University, 1959

This inquiry has a threefold purpose: to exemplify the influence of theories of human individuality on theories of human worth; to discover the relation of value and individuality; and to discover reasons which justify the attribution of worth to the human individual.

Concerning the first point, an examination of the history of philosophy reveals that, depending on the ontological status allotted to individuality (and the definition of value), one may view human individuality, or personality, as either non-value, disvalue, extrinsic and instrumental value, or intrinsic value.

The treatment of individuality as non-value is exemplified in the philosophies of Spinoza, Locke, Kant, Dewey, and Sartre. Although there are features among these theories which attribute extrinsic, instrumental and intrinsic worth to human individuality, these philosophers discover a more basic axiological element in either the not-being of man's individuality, the species-perfection that God allots to man, performance of duty, respect for duty and the moral law, means-end serviceability, or man's status as a useless passion for self-divinization.

Where value is identified with the fundamentally real, and human individuality is made distinct from this, as in Schopenhauer, the Indian mystics, and aspects of the philosophies of Plato and Aristotle, individuality will be accounted as disvalue except as it promotes its own abolition in union with that reality.

Some philosophers emphasize the contribution which the individual, as an aspect of the real, makes to the perfection of reality, to which his own intrinsic worth gives precedence and may even be sacrificed. This theme gains special recognition in the theories of Leibniz, Hegel and Nietzsche which emphasize the extrinsic and instrumental worth of man.

Other philosophers, however, point out that the contribution which the person makes to the whole is simultaneously a realization of his own intrinsic worth, his contribution to the realization of deity being an enhancement of his own personality rather than a sacrifice of his worth. Here the development of human individuality is identified with increasing reality and value. Royce, Whitehead, Wieman, and Brightman affirm that individualities are not instances of disvalue but intrinsically valuable elements of reality.

In the foregoing classes of theories, the axiological status of the human individual is either directly or indirectly affected by the ontological status assigned to human individuality.

Concerning the second point, the fulfillment of human

individuality is a realization of intrinsic value. The goal of life is Life. Those things which appear to be most abundantly alive are human persons whose lives are organized to realize a maximum of vivid and varied experience. To be richly alive, this is our raison d'etre; as unities of vivid experience we are most distinctly individual.

Agreeing with Robert S. Hartman, we describe the growth of individuality as the fulfillment of the person's descriptional concept. Human individuality is a continuum of ordered natural properties plus the person's consciousness of it. Thus the intrinsic worth of the person is realized as he fulfills his set of properties, i. e., his conception of himself, and consequently he realizes his own personality through increased richness of experience.

Concerning the third point, it must be emphasized that if man is valuable as an end in himself, if personality is an intrinsic value, then an account of this value must be given in terms of the person's own unique individuality. This seems to be more adequately accomplished when value is defined in terms of concept fulfillment. The human individual is of intrinsic worth because of the infinity of his intension as a unique thing, and because of the self-reflexiveness of his intension.

Microfilm $3.35; Xerox $11.40. 259 pages.

REASONS FOR THE IMPORTANCE OF A PHILOSOPHICAL STUDY OF SOME OF THE BASIC PRINCIPLES OF THE LIVING WORLD.

(L. C. Card No. Mic 59-4208)

John Herbert Haddox, Ph.D.
University of Notre Dame, 1959

There are today two schools of biologists with different views as to the nature of living organisms, and, consequently, with different methods of studying organisms and different explanations of living operations.

Members of one group of biologists, the physico-chemical school, assume that living organisms can be explained in terms of the physical and chemical reactions of their parts. Because of this assumption they concentrate on an analytic, emperiological study of the living thing.

Members of the other group of biologists, the organicists, affirm that living beings are essentially different from non-living beings, because living organisms are characterized by a specific type of organization and by "directive" activities toward certain ends, neither of which characteristics are found on the non-living level. Thus they feel that the physico-chemical methods alone are inadequate to explain living phenomena.

Who is right and who is wrong here, and do the principles of animate being presented by Aristotle and St. Thomas shed any light on the controversy? Is it possible that the principles of Aristotle and St. Thomas enable us to reconcile both conflicting opinions? Such is the problem of this dissertation.

In the attempt to solve this problem first the relation between a philosophical and a scientific study of the living world is explained, and then some of the results achieved by both the physico-chemical and the organicist schools of biologists are presented.

Next teachings of Aristotle and St. Thomas concerning the living world are examined; this includes a Thomistic analysis of Aristotle's two definitions of the soul. The first definition concerns the soul as substantial form of the body; so questions relating to the fact that the soul is the substantial form are examined. The second definition is concerned with the soul as the basic principle of operation in an organism and a final cause in two ways which are explained. Next St. Thomas' explanations of the vegetative form and functions are considered.

Finally, the positions of the two schools of biologists considered are evaluated in Aristotelian-Thomistic terms. The positive points in favor of the physico-chemical position and its weaknesses are presented; then the same is done for the organicist position; and, finally, the stand of Thomism with respect to the strengths and weaknesses of the other two positions is explained.

In summary now, the conclusions of this study are: 1) that the physico-chemical approach to living phenomena has been very successful in discovering details concerning the physico-chemical conditions for life, but that their analytic approach to living beings in terms simply of their chemical parts and the physico-chemical reactions taking place in and among these parts has a fundamental weakness in that the parts of the organism are not seen as parts of an organized whole in which the parts function together for the good of the whole organism; 2) that the organicists do recognize and emphasize the interrelatedness of the parts of a living organism and the directiveness of living functions toward the ends of self-perpetuation of the individual and its species, but that very often they have not concentrated enough on the physico-chemical conditions for these functions; 3) that the teachings of Aristotle and St. Thomas concerning the living contribute to an understanding of the order and methods to be employed in biology, and show us why both of the approaches to the living world of the biologists considered are necessary (with the physico-chemical school concentrating on the material and efficient causes of living functions and the organicists emphasizing the formal and final causes).

Microfilm $2.55; Xerox $8.80. 195 pages.

THE CONFLICT OVER THE WORLD'S PRE-ETERNITY IN THE TAHĀFUTS OF AL-GHAZĀLI AND IBN RUSHD.

(L. C. Card No. Mic 59-4955)

Michael Elias Marmura, Ph.D.
University of Michigan, 1959

The purpose of this study is to reveal the metaphysical conflict that underlies the debates on the world's pre-eternity in the Tahāfuts of al-Ghazāli and Ibn Rushd (Averroes). Through a detailed analysis of these debates it is shown how the conflict is essentially a conflict of incompatible metaphysical premises, that the disagreement over the question of the world's origin in the Tahāfuts does not represent an antinomy in the Kantian sense. Each of the disputing parties argues from a set of premises contrary to his opponents. The conflicting premises are often hidden in the arguments. The analysis extracts the hidden premises and demonstrates how the debates embody

a conflict of two opposing metaphysics, the metaphysics of the Islamic Aristotelian philosophers and the occasionalism of the Ash'arite theologians, championed by al-Ghazāli. In the light of such an analysis, Ibn Rushd's defense of the doctrine of the world's pre-eternity in his legal defense of philosophy, Faṣl al-Maqāl is then critically evaluated. The evaluation, it is hoped, will dispel some misconceptions concerning the relation of Ibn Rushd to revealed religion.

In chapter I al-Ghazāli's claim that in his Tahāfut he he does not represent any specific metaphysical school is questioned. Explicit metaphysical statements of al-Ghazāli are pointed out and hidden metaphysical assumptions in his arguments are extracted. These assertions and assumptions are shown to exhibit an identifiable metaphysical position, that of the Ash'arite occasionalists.

In chapters II and III the first debate is analyzed. It is shown that the conflict is a conflict of metaphysical premises pertaining to the nature of God, the cause. The Aristotelians argue from the premise that God acts by necessity. The world as the necessitated effect of an eternal changeless cause must be eternal. Against this al-Ghazāli argues from the Ash'arite premise that God is a voluntary agent not bound by any necessity.

The second debate that revolves around the concept of time is discussed in chapter IV. Here again it is shown that the conflicting premises still pertain to the nature of God as cause.

In chapter V the third and fourth debates are discussed. The conflict here pertains to the nature of the world, the effect. The philosophers uphold the Aristotelian theory that matter is eternal. Al-Ghazāli attacks this doctrine severely. Although his attack is negative in nature, it is argued that underlying this attack is his Ash'arite theory of the contingent atom.

In the final chapter Ibn Rushd's statements in Faṣl al-Maqāl are examined. His claim that the differences between the Ash'arites and the Aristotelians on the question of the world's origin are minor and reduce in large measure to a disagreement about naming is rebutted. It is shown that Ibn Rushd glosses over the essential differences implied in the two theories of the world's origin in an attempt to conceal the real discrepancies between his metaphysics and the more orthodox Islamic view of God and the world. Microfilm $2.65; Xerox $9.20. 201 pages.

DURATION AND METHOD IN THE PHILOSOPHY OF HENRI BERGSON.

(L. C. Card No. Mic 59-4461)

George Frederick Parker Ph.D.
University of Pittsburgh, 1959

Henri Bergson's philosophy is commonly associated with the method of intuition. It is also commonly held that Bergson was anti-intellectual and anti-scientific. Writing to Harald Höffding, he once said that intuition is primarily the intuition of duration and that many misunderstandings of the meaning of intuition arise from the failure to see that in his philosophy the concept of duration was developed earlier and that other aspects of his thought are dependent on it. It is the purpose of this study to examine the relationship between the concept of duration and Bergson's methodology.

Other statements Bergson has made indicate his intense desire to answer the scepticism of the neo-Kantians and the reductionism of the Positivists of his day. The first two brief chapters of this paper survey Bergson's life and the philosophical movements in which he matured and against which he reacted.

The third and fourth chapters expound the concept of real duration as opposed to spatialized time. Space is seen to be the symbol for the homogeneous, quantifiable, repeatable aspects of reality. In duration is found what is truly heterogeneous, qualitative, and personal. Space and duration are "limiting cases," abstractions which are only approached in reality. Concrete extension is diversified and organized; that is, it is characterized by some of the qualities of duration. Concrete duration necessarily becomes past time, losing its flexibility. The evolution of species and the development of individual personalities reveal the points of contact between the two limits.

Bergson was reluctant to use the term "intuition." He seems to have adopted it because "intellect" was so narrowly defined in his day. If intellect is able only to sort and categorize objects and plans of action, then what has traditionally been called "truth" is not available to it. Reality is discovered to be evolving and creative but the more precisely we refine our intellectual method, the more the evolution and creativity disappear. Intellect, like instinct, is an instrument for the organisms's survival. Like instinct, it has its merits and defects. The ability to abstract enables intelligent beings to deal with a tremendous range of material. Abstractness may also lead the organism into individually or socially harmful behavior, however. In mankind, intuition is the form which develops to counteract the destructive tendencies in intellect.

Intelligence is the proper instrument for science but its tendency is to treat nature according to its own ability to formulate questions. Intuition is an aesthetic method, oriented toward duration, sensitive to the empirically given multiplicity of experienced qualities, and sensitive to the "natural articulations" in reality, discussed here in chapter six. As duration is eminently personal, this theory involves a new view of personality.

Chapter seven presents briefly a few of Bergson's relevant remarks about the philosophic enterprise. If duration is true for the universe as a whole, the proper method for philosophy is intuition, which alone is able to grasp duration. Reality is not governed by the rules of the intellect and is not exhausted by the answers which we discover to our interested questions.

This study makes use of some resources not available in the libraries of this country. The material in French has been translated for use here, where no authorized translation exists, so that all quotations are in English.
Microfilm $2.30; Xerox $8.00. 174 pages.

THE EPISTEMOLOGICAL STATUS OF ETHICAL STATEMENTS FOR D. HUME AND C. I. LEWIS.

(L. C. Card No. Mic 59-4664)

John Winfield Sweigart, Jr., Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. E. F. Flower

The place of Hume, with respect to the status of moral judgments, has often been a point of controversy. Similarly, C. I. Lewis' work, which provides an excellent analysis of value theory as a form of empirical cognition, has left his position in the province of ethics somewhat in doubt. In recent years apparently incompatible interpretations have led to their being considered as cognitivists and as noncognitivists. More specifically, the opposing schools of ethical naturalism and emotivism have claimed Hume and Lewis in support of their views. The writings of the two philosophers bear an interesting parallel in the ways in which they have been construed and the major task of this dissertation is to examine their work to determine the justification for such interpretations.

Hume, of course, was not writing in the context of current ethical analysis. However, by reversing the chronology of Hume and Lewis, one finds that an initial treatment of Lewis provides insights regarding Hume, which more clearly bring the latter to bear on contemporary issues. From an examination of Lewis' work, attention is focused on two central points in Hume; the relation between matters of fact and matters of value and ethics, and the parallel problem of the nature of the connection between "is" and "ought" statements.

The two leave their positions in ethics open by encountering the same general sort of difficulty in trying to make an adequate transition from the is statements of factual judgments to the ought statements regarding moral judgments. While both correctly recognize that a relation between "is" and "ought" is not merely a deductive one, they do not give a sufficient account of the nature of this connection. With Hume, general rules of experience apply to both areas but the additional obligatory feature of rules regarding morality and the precise nature of the kind of feeling involved with moral sentiments is not made clear. In his pragmatic analysis, Lewis relates empirical cognition to morality by showing the pervasiveness of the normative element in scientific as well as moral endeavor. However, the overriding imperativeness of what is right in the ought statements of the moral critique Lewis grounds in the social history of human nature and does not explicate the matter further.

Some of Hume's analysis, especially his attacks against the roles traditionally assigned to reason and feeling, no doubt provided impetus to the rise of emotivism. Also, Lewis' particular stress on the need for rules and imperatives, in addition to correct value judgments to determine what is objectively right, indicates antinaturalistic features in his theory. Thus, perhaps the two are not ethical naturalists in the full sense of the term. But their views are cognitive rather than noncognitive. Their moral theories are not to be identified with emotivism. For Hume the importance given to feelings as the foundation for empirical endeavor is as great in the factual as in the moral area. And for Lewis, the imperatives, which are basic to all empirical action, are always held to be rational.

In determining the above conclusions, it was necessary, of course, to point out and analyze the similarities between factual and moral matters, which Hume and Lewis incorporate in their systems. Recognition of such connections in their theories also has further significance, since these connections provide damaging evidence against the acceptance of any hard and fast separation of epistemology and ethics on the basis of what is cognitive and what is noncognitive. Microfilm $2.75; Xerox $9.60. 211 pages.

THE LOGIC OF OBLIGATION.

(L. C. Card No. Mic 59-4404)

Malham M. Wakin, Ph.D.
University of Southern California, 1959

Chairman: Professor Werkmeister

Aristotle, St. Thomas Aquinas, and Kant are among the major philosophers who have held that we may have recourse to some logical process of reasoning in determining whether an act should or should not be done. Certain modern philosophers, however, adopting the Kantian emphasis on the imperative function of obligation sentences, have rejected the possibility that obligation sentences may occur as elements in logical inferences. If obligation sentences are imperatives, then they cannot be true or false, and, ostensibly, sentences which cannot be true or false cannot occur as elements in theoretical logical inferences. This apparent obstruction to the search for a logic of obligation is circumvented by an investigation of the possibility that obligation sentences (whether considered true or false, or not) may occur in inferences of a type different from that of theoretical inferences.

Two major approaches in recent attempts to construct formalized systems for obligation sentences are distinguished. The imperative approach attempts to include the logic of obligation as a part of a general logic of imperatives. This approach is shown to be relatively unfruitful. Some of the imperative systems make the imperative element itself superfluous, concluding that an imperative can be derived from an indicative alone. Moreover, so long as it fails to recognize the distinction between an obligation to perform an action and a command to perform an action, the imperative approach cannot hope to reveal the logical characteristics of obligation sentences.

The normative approach, beginning with G. H. von Wright's "Deontic Logic" (1951), shows far more promise of providing an adequate formalized system for obligation sentences. The outstanding feature of the normative approach is the fact that it recognizes an independent deontic modality. The deontic modalities (the obligatory, the permitted, and the forbidden) are in many ways analogous to the alethic modalities.

Some of the shortcomings of the systems based upon the normative approach are traced to a failure properly to account for the role of circumstances affecting any given action. Consideration of the basic relationships

between the obligatoriness of an action and the circumstances involved in performing that action lead to a threefold classification of the types of obligation. An absolute obligation is one which holds in every possible set of circumstances; a universal obligation holds for all men in analogous sets of circumstances; an individual obligation is the obligation of this particular agent to perform this particular act. The vertical relationships of the three types of obligation sentence are described in a system (V) of subsumption inferences (practical syllogisms). A small number of rules provides a testing procedure for determining the valid moods of the practical syllogism. The general practical syllogism (a syllogism the conclusion of which is a universal obligation sentence) is shown to have five valid moods. Of these five, only three are valid for the strictly practical syllogism (a syllogism the conclusion of which is an individual obligation sentence).

The horizontal logical relationships of obligation sentences are relevant only on the level of universal obligation sentences. An axiom system, H, which formally displays several of the horizontal logical relationships of obligation sentences, is given in moderate detail. The concepts of prohibition and permission are introduced definitionally in H in terms of obligation. Several intuitively acceptable theorems involving the deontic concepts are shown to be provable in H.

Microfilm $2.95; Xerox $10.20. 228 pages.

PHYSICS

PHYSICS, GENERAL

EFFECT OF ION BOMBARDMENT ON SEMICONDUCTOR SURFACES.

(L. C. Card No. Mic 59-4486)

Stephen Reynolds Arnold, Ph.D.
University of Illinois, 1959

Measurements of surface properties of etched germanium surfaces were carried out before and after bombardment by 500 and 1000 volt oxygen ions. Simultaneous photoconductance and field effect measurements were made in vacuum at room temperature in an effort to correlate surface lattice disorder with the surface state structure. Bombardment is shown to have the general effect of increasing the surface state density without causing major changes in the trapping structure. Comparison of changes in surface recombination with changes in over-all charge localized in fast states indicates that the density of the dominant recombination centers in etched surfaces may be more than an order of magnitude smaller than commonly reported. Evidence is presented to suggest that the ability of conventional field effect experiments to measure the densities of the dominant recombination centers in such surfaces may be open to question. Surface recombination velocity behavior is roughly indicative of a dominant recombination center located 5 to 6kT above mid-gap. On the basis of changes in total trapped charge after bombardment an upper limit of approximately 5×10^9 cm^{-2} is set for the density of such a center on the etched surface, requiring a minimum hole capture cross-section of $2 \times 10^{-13} cm^2$. The effect of ion bombardment on the rectification properties of silicon surfaces reported by Ohl is verified.

Microfilm $2.00; Xerox $5.20. 102 pages.

AN INTERFEROMETRIC STUDY OF SHOCK TUBE BOUNDARY LAYERS.

(L. C. Card No. Mic 59-4289)

John Robert Asbridge, Ph.D.
Lehigh University, 1959

Boundary layers in the hot gas flow behind the shock wave on the walls of a rectangular shock tube have been studied for eleven flow conditions by observing their density structure with a Mach-Zehnder interferometer. These eleven conditions include three which have supersonic flow behind the shock wave relative to the walls while the other eight conditions produce subsonic flow.

The boundary layers are observed to be thin and slowly growing at first, with the structure and growth rate predicted for laminar layers.

The laminar flow extends for a limited distance behind the shock wave, and the boundary layer structure then gradually departs from the laminar and becomes similar to that observed in wind tunnel steady turbulent boundary layers over a flat plate. The departure from laminar flow may be characterized by a Reynolds number based on the distance that the gas particles travel after being set in motion by the shock before starting their turbulent behavior. This transition Reynolds number is found to increase with increasing shock strength and ranges from about 1×10^6 to 3×10^6 for flow over a polished steel surface as the shock Mach number goes from 1 to 4.5. Over a rougher machined duralumin surface, the transition Reynolds numbers are of the order of 1/4 those characteristic of the polished steel surface, indicating that transition is determined to a large part by the nature of the surface over which the flow is started. The transition zone extends in most flows for a few inches as the boundary layer structure progresses from the laminar to the turbulent type. The structure of the transitional boundary layer is believed to be consistent with a turbulent spot mechanism of transition.

When transition is completed, the boundary layer structure is compared to that resulting from an assumed power law dependence of velocity on distance from the

wall, with the Crocco relationship assumed between the temperature and the velocity. The turbulent boundary layers for the supersonic flow cases have a structure that is in agreement with a 1/7 power velocity profile. For the subsonic flows, the structure is nearly in agreement with the 1/7 power velocity profile, but in general shows a systematic difference, with a higher power index needed near the free stream than that needed to fit near the wall. The growth rate for all cases is very nearly that predicted on the basis of a 1/7 power velocity profile.

Free stream density variations in the flow occur in coincidence with the boundary layer growth. After an initial increase above the value attained immediately behind the shock, the free stream density decreases for the remainder of the laminar flow, and often goes below the value immediately behind the shock. Shortly after transition the density begins to rise, and eventually always exceeds the value just behind the shock. After boundary layer closure, the density rises even more rapidly.

Microfilm $2.00; Xerox $5.40. 107 pages.

THE IRREVERSIBLE THERMODYNAMICS OF NON-LINEAR PROCESSES AND NOISE IN DRIVEN SYSTEMS.

(L. C. Card No. Mic 59-4595)

William Bernard, Ph.D.
University of Pennsylvania, 1959

Supervisor: Herbert B. Callen

In this paper we review and extend the existing theory of irreversible thermodynamics. In addition to the fluctuation-dissipation theorem, which relates the macroscopic response to the equilibrium fluctuations, we prove several new relations among the non-linear response, the driven noise, and the equilibrium fluctuations. The Hamiltonian used to characterize the driven system is that assumed previously by Callen and Welton, in which the perturbation term involves the products of conjugate intensive parameters F_i and extensive variables q_i. The motion of the driven system is described in terms of a statistical mechanical perturbation expansion in the applied forces F_i similar to that employed by Kubo and others. The character of the results achieved is exhibited by the following particularly simple classical relationships for step-driven processes. Let $\langle q_i(t)\rangle$ denote the response of the variable q_i to a step-function force of magnitude F_j, and let $\langle q_i(t_1)q_j(t_2)\rangle$ be the second correlation moment (noise) between q_i and q_j at times t_1 and t_2, during the step-driven process. Further, let $\langle q_iq_j(t)\rangle^{(0)}$ and $\langle q_iq_j(t_1)q_k(t_2)\rangle^{(0)}$ denote the second and third correlation moments, respectively, of the spontaneous equilibrium fluctuations. Then it is shown that

$$\frac{\partial\langle q_i(t)\rangle}{\partial F_j} = -\frac{1}{kT}\langle q_jq_i(t)\rangle^{(0)}$$

$$\frac{\partial^2\langle q_i(t)\rangle}{\partial F_j\,\partial F_k} = -\frac{1}{kT}\frac{\partial\langle q_jq_i(t)\rangle}{\partial F_k} = \left(\frac{1}{kT}\right)^2\langle q_jq_kq_i(t)\rangle^{(0)}$$

where the derivatives with respect to the applied forces F_j are evaluated at $F_j, F_k, \ldots = 0$. The first expression is the fluctuation-dissipation theorem for first order processes, while the second characterizes the type of extension of the theory undertaken in this paper. Analogous relationships are established both for arbitrary processes and for the non-classical case. In addition, a theorem relating to the distribution function of the several variables in the course of an irreversible process is obtained. Microfilm $2.00; Xerox $7.00. 146 pages.

PHOTOIONIZATION INDUCED ION-MOLECULE REACTIONS IN A MASS SPECTROMETER.

(L. C. Card No. Mic 59-3513)

Gilbert Richard Cook, Ph.D.
University of Southern California, 1959

Chairman: Professor Weissler

A seya type vacuum monochromator has been combined with a single focusing Nier type mass spectrometer to study ions formed as a result of photoionization of gases in the 10 to 25 ev (1250-500A) range. The formation of ions was observed to occur by direct photoionization of a neutral molecule X or by a secondary ion-molecule reaction between the photoionized molecule X^+ and a neutral one W. The direct and secondary processes are represented by the equations

$$X + h\nu \rightarrow X^+ + e, \qquad (1)$$

where $h\nu$ is the photon energy and e the electron released from X by photoionization, and

$$X^+ + W \rightarrow Y^+ + Z, \qquad (2)$$

where Y^+ is the product ion formed by the collision between a neutral molecule W and X^+, and Z is a neutral fragment.

The primary aim of this research was to look for ions formed by process (2) and to determine the rate constant and cross section for the formation of Y^+. The gases investigated were hydrogen, methane, and a one-to-one mixture of hydrogen and nitrogen, and the product ions observed were H_3^+, CH_5^+, and N_2H^+, respectively. Reaction rate constants and cross sections were found to be of the order of 10^{-9} cm^3/molecule sec and 10^{-14} cm^2, the latter being approximately two orders of magnitude greater than the kinetic theory collision cross section for similar atoms and molecules.

For process (1) the appearance potential of X^+ as well as the variation of ion intensity with wavelength was determined for H_2^+, CH_4^+, CH_3^+, and N_2^+. In many instances ion intensity variations could be correlated with the onset of higher ionization potentials, corresponding to an ion in an excited state, or with a dissociative ionization process. The appearance potentials of secondary ions H_3^+, CH_5^+, and N_2H^+ were found to equal that of the primary ions producing them within the limits of experimental error of about $\pm$ 0.3 ev.

Rate constants and cross sections for ion-molecule reactions determined in this research were found to be of the same order of magnitude as those previously reported with electron impact methods and with theoretically predicted values. Appearance potentials of primary ions

were also found to be in agreement with the results of spectroscopic and electron impact work.

Microfilm $2.00; Xerox $5.80. 117 pages.

THEORY OF DIRECT INTERACTION INELASTIC SCATTERING.

(L. C. Card No. Mic 59-4005)

Norman Keith Glendenning, Ph.D.
Indiana University, 1959

A model for direct interaction nucleon inelastic scattering by complex nuclei is developed. The incident nucleon interacts directly with a single nucleon in the nucleus, imparting energy and momentum to it. The residual nucleus accordingly differs from the target in the quantum numbers of a single nucleon. The bound nucleons are represented by appropriate shell model wave functions. The radial functions are chosen to be harmonic oscillator functions. Elastic scattering of the free nucleon before and after the direct interaction is accounted for by the use of waves distorted by a complex square well potential, which is supposed to represent the effect of the entire nucleus on the free particle. A Gaussian potential is used for the surface interaction which is effective only when the incident nucleon lies on the nuclear surface. All integrations can be performed explicitly. Arguments are given to justify the use of a surface interaction under suitable conditions.

The principle approximations, such as use of a square distorting potential, surface interaction, pure shell model wave functions, and non-antisymmetrization of the total wave function with respect to the exchange between free and bound nucleons, are examined quantitatively.

A comparison of the theory with some of the appropriate experiments involving nucleon scattering from resolved levels in C^{12}, O^{16}, Pb^{206} and alpha particle scattering from C^{12} is made.

In the appendices other direct processes are discussed briefly, and a comparison is made with the direct nuclear interaction process. In particular, it is shown that for small deformations, inelastic scattering by excitation of a collective surface motion in deformed nuclei should give rise to cross sections identical, aside from a factor, to scattering by direct nuclear interaction, in the limit of a surface interaction.

It is concluded that the distortion of the incident and outgoing waves is dominant in determining the shapes of the angular distributions. The shapes of the cross sections, both differential and total, are rather insensitive to the single particle transition caused by the direct interaction, except insofar as they determine the allowed angular momentum transfers. However the single particle configurations are crucial in determining the intensity of excitation of the various levels in the nucleus, some levels being excited with an intensity 100 times as great as others. Microfilm $2.00; Xerox $6.20. 127 pages.

A MEASUREMENT OF THE FISSION-TO-INDIUM AGE OF NEUTRONS IN WATER.

(L. C. Card No. Mic 59-5117)

David Bishop Lombard, Ph.D.
The Pennsylvania State University, 1959

A re-measurement of the fission-to-indium age of neutrons from a point U^{235} fission source in water is reported. This work was prompted by the long-standing discrepancy between the theoretical value of the age (26 cm^2) and the values obtained in previous experiments (30 cm^2). The age, τ, may be defined by the equation

$$\tau(E) = \frac{1}{6} \frac{\int_0^\infty r^2 \, \phi(r,E) 4\pi r^2 \, dr}{\int_0^\infty \phi(r,E) 4\pi r^2 \, dr} = \frac{1}{6} \langle r^2 \rangle \qquad (1)$$

where $\phi(r,E)\, dx\, dy\, dz\, dE$ is the number of neutrons with energy in dE at E and position dx dy dz a distance r from the source.

In this experiment, τ(1.45 ev.) was measured. Neutrons are readily detected at 1.45 ev. by indium foils, since there is a large narrow resonance in the neutron absorption cross-section spectrum of indium at that energy. Cadmium boxes served to shield the foils from thermal neutrons which also cause activation in indium. Cadmium-covered foils were placed (with an accuracy of $\pm$ 0.1 cm) at various distances up to 50 cm from a small U^{235} fission source, itself placed near the graphite thermal column under water at the Pennsylvania State University research reactor. A 5 inch thick lead shield between reactor core and thermal column served to reduce the flux of gamma rays from the core. Devices for holding the source and foils were constructed principally from polyethylene, the composition of which is similar (in terms of neutron interactions) to water. About 20 exposures of three or four foils each were made in determining the age. In addition, numerous auxiliary experiments were conducted to investigate the effects of pool background, absorption by the source of indium resonance neutrons, the presence of aluminum in the experimental region, foil activation by neutrons at energies other than 1.45 ev., photoneutrons due to the presence of the source, and foil self-absorption of β-activity. The foils were counted in proportional flow-counters.

Saturation activities of foils were computed from the raw data; corrections were then made for pool background, and for finite source and foil geometry. In addition, a rather troublesome correction was made for absorption of indium resonance neutrons by the source; another correction was made for the lack of proportionality between the foil activity and the indium resonance flux.

The spatial distribution thus obtained was found to be appreciably steeper near the source than that obtained in previous experiments. The distribution in this region agrees well with the Monte Carlo calculation of Beach and Podger. A value of the age was obtained from the data by a numerical evaluation of equation (1), substituting foil activities for $\phi(r,E)$. This value is

$$27.3 \pm < 0.9 \text{ cm}^2,$$

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

which compares favorably with the current theoretical value of

$$26.0 \pm 0.5 \text{ cm}^2.$$

Microfilm $2.00; Xerox $5.20. 105 pages.

VARIATION OF LOW TEMPERATURE HEAT CAPACITY WITH HARDNESS IN AN ALUMINUM ALLOY.

(L. C. Card No. Mic 59-4546)

Frederick August Otter, Jr., Ph.D.
University of Illinois, 1959

The specific heat of a dilute alloy of Mg(0.7 percent) and Si(0.3 percent) in aluminum has been measured down to 1.8°K. The hardness and mechanical strength of this alloy varies with the degree of precipitation of Mg_2Si from supersaturated solution and can be controlled by heat treatment. Measurements have been made in the annealed and fully hardened conditions. From 1.8 to 4.2°K, the specific heats of hard or annealed specimens can be represented by $C = \gamma T \pm 1.944 \times 10^6 (T/\theta_D)^3$ mj/mol-deg with $\gamma = 1.33 \pm 0.02$ mj/mol-deg^2 and $\theta_D = 430 \pm 4$°K for the case of the annealed specimen. For the hard specimens, $\gamma = 1.35 \pm 0.02$ mj/mol-deg^2, and $\theta_D = 436 \pm 4$°K. In this temperature range, γ and θ_D increase for the alloy in the hardened condition. The changes are $d\gamma/\gamma = 1.1 \pm 0.5$ percent and $d\theta_D/\theta_D = 1.3 \pm 0.6$ percent. No change in θ_D was observed from 10 to 20°K. These results are compared to the change in the superconducting critical temperature found for the same alloy ($dT_c/T_c = -4.6$ percent) by Mould in 1954. The discussion is based on the recent theory of superconductivity of Bardeen, Cooper, and Schrieffer and on Morel's calculation of the quantity N_oV which appears in that theory. The experimental results seem consistent with this treatment and with the experimental correlation between γ, T_c, H_o, and θ_D that exists among superconductors and which was recently published by Goodman.

Microfilm $2.00; Xerox $4.60. 87 pages.

THEORY OF THE PHOTODISINTEGRATION OF THE DEUTERON.

(L. C. Card No. Mic 59-4650)

Leon Donald Pearlstein, Ph.D.
University of Pennsylvania, 1959

Supervisor: Abraham Klein

A covariant field theoretic technique[1] have been employed to derive a formally exact expression for the amplitude for photodisintegration of the deuteron. Assuming that the meson-meson interaction is unimportant and that nucleons interact via p-wave mesons only, we can, by invoking the adiabatic approximation and by limiting ourselves to single meson exchanges, reduce this expression to one in which the corrections to the conventional matrix element depend only on the amplitude for photomeson production, the renormalized meson-nucleon coupling constant, and the appropriate two nucleon wave functions. The results of the numerical analysis, which are in rather good agreement with experiment for the energy range 0 to 400 Mev,[2] indicate that virtual mesons play an unimportant role at low energies as predicted by Siegert's theorem,[3] and that the total and folded differential cross sections at the higher energies (150 to 400 Mev) can only be predicted if we include the D state of the deuteron and employ hard core wave functions in the initial and final state.

Microfilm $2.00; Xerox $5.80. 119 pages.

1. A. Klein and C. Zemach, Phys. Rev. 108, 126 (1958).
2. We have included the results of the calculation at the lower energies by J. J. de Swart and R. E. Marshak, Phys. Rev. 111, 272 (1958).
3. A. J. F. Siegert, Phys. Rev. 49, 904 (1936).

DEPTH OF PENETRATION OF ELECTRONS IN X-RAY TARGETS.

(L. C. Card No. Mic 59-4741)

Sema'an Ibrahim Salem, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Harold P. Hanson

The ratio of the intensities of the K_{α_1} and K_{β_1} lines was found to change with voltage; this change was attributed to the fact that the effective depth of formation of K-radiation changes with voltage also, thus changing the distance traveled by such radiation before leaving the target. This allows the K_{α_1} line to be absorbed more effectively at higher voltages.

K-radiation is not all formed directly by cathode rays, but a known percentage of it is formed by bremsstrahlung radiation. A metal different from the target was plated on to stop the electrons. Thus, the K-radiation in the base target is only produced by bremsstrahlung. From the change in the ratio of the K_{α_1} and K_{β_1} lines of the base target with applied voltage, the change in the effective depth of the indirectly formed K-radiation was measured.

Making use of the two measured quantities $(\Delta t/\Delta v)$ and $(\Delta t/\Delta v)_{ind}$ (the change in the effective depth of the total K-radiation and of the indirectly formed K-radiation) and the direction in which the bremsstrahlung radiation travels with respect to the motion of the parent electrons, the effective depth of penetration of electrons was calculated.

The value of the effective depth was corrected for self-absorption in the target and thus the mean depth of penetration of 20,000 volts electrons in copper and in nickel was found.

Microfilm $2.00; Xerox $4.20. 77 pages.

PHYSICS, ELECTRONICS AND ELECTRICITY

THE ATTACHMENT OF SLOW ELECTRONS IN OXYGEN.

(L. C. Card No. Mic 59-4434)

Lorne Maxwell Chanin, Ph.D.
University of Pittsburgh, 1959

The present investigation was undertaken in an attempt to clarify the electron attachment processes in oxygen occurring at low electron energies. The experimental results reported cover an energy range from 0.04 ev to approximately 3 ev. Measurements were made using an electron swarm method, adapted to the use of modern pulsing and timing techniques. In addition to measurements in oxygen, studies were also conducted in oxygen-helium and oxygen-nitrogen mixtures. In the mixture measurements, oxygen concentrations were approximately 1 - 4 per cent. In addition to the studies at room temperature, measurements in oxygen-helium mixtures were conducted at 77°K.

Results of the present study reveal that the attachment of low energy electrons in oxygen occurs by two separate processes. For $E/p > 3$ the attachment process consists of a two-body process, whereas for $E/p < 2$ the attachment involves a three-body process. The measurements for $E/p > 3$ are consistent with the results of previous swarm experiment studies. In addition these results are in agreement in this energy range with previous attachment studies using electron beam techniques, when proper averaging over the electron energy distribution is taken into account. In view of this, the attachment process is interpreted in terms of dissociative attachment to form O^-.

The present results for $E/p < 2$ reveal that the attachment coefficient depends on the square of the oxygen pressure. This dependence was observed for oxygen pressures from 7.6 to 54 mm Hg. This behavior was not observed in previous studies in this energy range. A review of the data of previous swarm experiment studies, however, shows that re-evaluation of the data in those cases in which sufficient experimental detail is given, provided qualitative agreement with the present findings. The present measurements extend to considerably lower average electron energies than had previously been attained using similar techniques. The results show that the three-body attachment coefficient varies inversely with the square root average electron energy down to an energy ~ 0.1 ev. At this energy the three-body attachment coefficient is 4.9×10^{-30} cm^6/sec. The value of the coefficient then decreases to a value of 2.8×10^{-30} cm^6/sec at an energy ~ 0.04 ev. These results may be compared with the Bloch-Bradbury theory of electron attachment in oxygen. The present data show that the theoretical assumption that the attachment cross section has the form of a delta function at 0.1 ev is not valid. The measurements are, however, consistent with the predicted threshold in the vicinity of 0.1 ev.

The results for $E/p < 2$ are interpreted in terms of the production of O_2^- as the result of collision stabilization of a temporarily excited negative ion. An alternate description to the Bloch-Bradbury ion formation process is given in terms of the formation of a temporary O_4^- ion which dissociates into O_2^- and O_2. In the absence of detailed knowledge of the potential energy curves of O_2^-, it is concluded that unless near resonance conditions prevail for the transfer of energy from O_2^{-*} to O_2, the ion formation process will proceed by this mechanism.

In order to establish better the average electron energy scale, measurements were undertaken in oxygen-helium mixtures. These measurements were made at 77°K and 300°K. In general the variation of the attachment coefficient with electron energy at 77°K is quite similar to the behavior at 300°K. For average energies exceeding 0.07 ev, however, the attachment coefficient values are considerably higher than the corresponding values at 300°K. Studies were also conducted in oxygen-nitrogen mixtures at room temperature. The mixture measurements permit comparison of the efficiencies of helium and nitrogen as stabilizing agents. The data show that the order of decreasing efficiency is oxygen, nitrogen, and helium. At 0.1 ev nitrogen is approximately forty, and helium approximately two-hundred times less efficient than oxygen.

Partial confirmation of the present findings has recently been obtained in a number of subsequent studies on electron attachment using other techniques.

Microfilm $2.00; Xerox $5.40. 106 pages.

INELASTIC COLLISION CROSS SECTIONS FOR PROTONS AND HYDROGEN ATOMS IN MOLECULAR HYDROGEN.

(L. C. Card No. Mic 59-4442)

Robert K. Curran, Ph.D.
University of Pittsburgh, 1959

Measurements of the single electron capture cross section, σ_{10}, for protons of energies 2.5 to 60 Kev are reported and measurements of single electron capture and loss cross sections for atomic hydrogen, $\sigma_{0\bar{1}}$ and σ_{01}, respectively, over the same energy range. Reported for the first time are measurements of the total cross section for production of ion pairs by hydrogen atoms in molecular hydrogen. A result of the measurements of electron loss by hydrogen atoms is an apparent correlation with H^- formation cross sections for electron impact on molecular hydrogen.

Microfilm $2.00; Xerox $3.00. 44 pages.

THE ELECTRONIC SPECIFIC HEATS OF SOME NICKEL-ALUMINUM ALLOYS. THE LOW TEMPERATURE HEAT CAPACITY OF Ta_2H.

(L. C. Card No. Mic 59-4448)

Guido Galli, Ph.D.
University of Pittsburgh, 1959

The interstitial compound, Ta_2H, was studied calorimetrically from 1.5°K to 15°K. A specific heat anomaly below 4°K that was discovered with this as well as another

alloy was postulated to be an effect of exchange gas adsorption. Surface area measurements made on this sample were in agreement with this postulate. This particular alloy was chosen for study because entropy measurements were considered necessary not only to complete a thermodynamic study of this material but also for theoretical considerations concerning the structure of the alloy.

The electronic specific heats of some alloys of the NiAl β-phase were measured. The purpose of this work was to determine the shape of the density of states curve in the region where the Fermi surface is approaching a Brillouin zone face. These alloys were prepared by a levitation melting technique under a protective atmosphere of argon. A standard gravimetric analysis was employed to determine the compositions. Heat capacity measurements were then made from 5°K to as low a temperature as was possible. It was found that the heat capacities of the nickel-rich alloys contained an anomalous contribution at low temperatures.

Magnetic susceptibility measurements were also made on the NiAl alloys in an attempt to gain a better understanding of the effects associated with the heat capacity data. These measurements were made from room temperature to about 600°K. The alloys were found to be moderately paramagnetic. The paramagnetism decreased with both increasing temperature and increasing aluminum concentration.

The density of electron states curve is given for the β-phase NiAl system. The curve that was determined by experiment does not appear to agree with what is predicted by band theory. Two interpretations are given for the results of this work.

Microfilm $2.00; Xerox $4.20. 77 pages.

A SEARCH FOR POLARIZATION OF FIELD-EMITTED ELECTRONS.

(L. C. Card No. Mic 59-5122)

Walter Thornton Pimbley, Ph.D.
The Pennsylvania State University, 1959

Experiments were performed designed to detect polarization of field-emitted electrons using Mott scattering. Electrons emitted from various crystallographic planes of a clean tungsten surface, from individual quarters of a phthalocyanine quadruplet on a clean tungsten substrate and from single ferromagnetic domains of iron were analyzed in a temperature range from 21°K to 900°K. In no case was any polarization detected. The average least detectable asymmetry factor that could be determined by the apparatus was calculated to be .04 corresponding to a polarization of 10% in a plane normal to the field emitted beam.

Microfilm $2.00; Xerox $3.00. 60 pages.

THE CONDUCTANCE OF A CLEANED GERMANIUM SURFACE.

(L. C. Card No. Mic 59-4552)

William Manos Portnoy, Ph.D.
University of Illinois, 1959

The conductivity and field effect mobility of the carriers in the region of the space charge of a cleaned germanium surface were measured as a function of various gas ambients and as a function of temperature. The carriers in the region of the space charge at a germanium surface, cleaned by argon sputtering and annealing, were found to be p-type in character and to exhibit the characteristics of a degenerate gas. Adsorption of water vapor on the surface decreased this p-type space charge region while atomic hydrogen enhanced it. Adsorption of oxygen first enhanced the p-type region and then decreased it. The p-type region arises from the nature of the germanium surface atoms. These atoms act as acceptors by trapping an electron from the bulk into their unfilled orbitals at the surface. Although there should be $10^{15}/cm^2$ of these states the present experiments indicate that their number is greater than $8 \times 10^{12}/cm^2$, and may be as large as $8 \times 10^{13}/cm^2$-eV. The field effect experiments indicate that these states lie within 0.022 eV above the edge of the valence band. The measurements of the excess conductivity associated with this region of space charge as a function of temperature substantiate the degeneracy of the valence band by showing only a very slight variation over the range 77°K-300°K. Quantitative analysis of the temperature data must await the results of measurement of the Hall mobility of the holes in the region of the space charge. However, rough estimates indicate that the number of holes in the region of the space charge does not change by more than a factor of two over the range of temperature investigated.

Microfilm $2.00; Xerox $4.40. 82 pages.

PHYSICS, METEOROLOGY

LOW-LEVEL ATMOSPHERIC TURBULENCE AND ENVIRONMENTAL PARAMETERS.

(L. C. Card No. Mic 59-5102)

Raymond John Deland, Ph.D.
The Pennsylvania State University, 1959

The purpose of the investigation was to relate low-level atmospheric turbulence spectra to wind speed, temperature lapse rate, height above the ground, and ground roughness.

The data analyzed consisted of turbulence spectra calculated from observations of the fluctuating wind speed and direction. The variation of direction was measured in both the horizontal and vertical planes. The first set of observations was made by Atomic Energy Commission staff on the hundred-meter tower at Brookhaven National Laboratory, Long Island, during the years 1951-1954 inclusive. The second set of observations was made by

staff of the Round Hill Field Station of the Massachusetts Institute of Technology during the Great Plains Turbulence Field Program at O'Neill, Nebraska, in the summer of 1953.

In the analysis the high frequency (150-250 cycles per hour) and low frequency (10-60 cycles per hour) turbulence were considered separately. The Brookhaven data at each level were used to calculate multivariate linear regressions on the lapse rate and the square of the mean wind speed. The O'Neill data were analyzed by more complicated regression methods. The effect of ground roughness was estimated by comparison of the results from the two places in similar conditions, the terrain being greatly different at the two places. This comparison required extrapolation with respect to height, since the Brookhaven observations were made at 23, 46, and 91 meters and the O'Neill observations at 1.5, 3, 6, and 12 meters.

Detailed results were obtained for the relations of the different components of atmospheric turbulence to meteorological parameters. The results for the variation with roughness indicate that in neutral stability conditions it is the same for the two frequency ranges considered, and in agreement with that deduced from the roughness parameters obtained from logarithmic wind profiles. When the temperature lapse rate is superadiabatic, i.e. in unstable conditions, the variation with roughness is less for the low frequencies.

Microfilm $2.00; Xerox $5.20. 101 pages.

PHYSICS, NUCLEAR

SYMMETRY STUDIES IN j-j COUPLING.

(L. C. Card No. Mic 59-4136)

David William Dorn, Ph.D.
Purdue University, 1959

Major Professor: Richard W. King

This thesis is concerned with the investigation of spatial symmetry properties of j-j coupled wave functions for nuclei. As is well known, the requirements of j-j coupling and spatial symmetry are in direct opposition. This has the result, in light nuclei ($A < 16$), of forcing us to adopt an intermediate coupling scheme description. However, as we go to heavier nuclei, the j-j coupling description becomes non-unique, and we may then apply any one of several criteria to obtain unique wave functions. The criterion chosen in this thesis was to maximize the type of structure characterized by a completely symmetric space wave function times a completely antisymmetric spinisotopic spin function. Configurations for which a decomposition of this type is possible (two or less of a given kind of nucleon) were designated as "simple configuration." Configurations for which this decomposition is not possible ("complex configurations") were constructed by vector coupling the simple configurations in the proper fashion.

Wave functions obtained in the above manner were used to calculate nuclear magnetic dipole moments and beta decay matrix elements. The magnetic moments, with one exception, were within about 10% of the experimental values. The beta decay matrix elements, when combined with the experimental log ft values, yielded a significant grouping about the value log ft $|M|^2 \approx 4.1$. This should be compared with the expected value of about 3.5. Some possible reasons for this deviation are Coulomb effects, configuration admixing, and core effects.

Microfilm $2.00; Xerox $4.40. 84 pages.

STUDY OF SOME REACTIONS OF 15 MEV DEUTERONS WITH THE LITHIUM ISOTOPES.

(L. C. Card No. Mic 59-4452)

Ernst Wolfgang Hamburger, Ph.D.
University of Pittsburgh, 1959

Metallic targets of enriched Li^6 and Li^7 were bombarded with 15 Mev deuterons. The outgoing particles were magnetically analyzed and detected in nuclear emulsions or scintillation counters. Angular distributions for the following reactions were measured: $Li^6(d,p)Li^{7*}$ 4.6 and 7.46 Mev, $Li^7(d,p)Li^{8*}$ 2.28 Mev, $Li^7(d,t)Li^{6*}$ 3.57 Mev, $Li^6(d,d')Li^{6*}$ 2.19 Mev, $Li^6(d,\alpha)He^4$ g.s., $Li^6(d,t)Li^5$ and $Li^6(d,He^3)He^5$. No new levels were observed; upper limits on the cross sections of unobserved levels are given. The results of the (d,p) (d,t) and (d,He^3) reactions were compared with stripping theory and with the predictions of the shell model. The agreement is, in general, satisfactory.

The $Li^6(d,t)$ and $Li^6(d,He^3)$ reactions produce a continuous spectrum of outgoing particles at each angle. The angular distribution of the tritons (or He^3 particles) is strongly peaked forward and can be fitted with Butler curves having $\ell = 1$, $r_0 = 6f$. The spectra at small angles show a peak corresponding to the Li^5 (or He^5) ground state, but at large angles the peak disappears and the spectra are constant. The shape of the spectra can be explained by the Butler formula if the energy dependence of the reduced width is taken into account. The form of this dependence can be deduced from the results of the nucleon-Helium elastic scattering experiments.

Microfilm $2.00; Xerox $6.40. 131 pages.

VIRTUAL LEVELS IN N^{15}.

(L. C. Card No. Mic 59-4722)

Jerry Duane Henderson, Ph.D.
The University of Texas, 1959

Supervisor: Professor E. L. Hudspeth

Thin carbon targets 33 per cent enriched in C^{14} were bombarded with protons at energies between 2.0 and 3.0 Mev. A 3 x 3-inch NaI crystal was used to observe γ-rays at 90° from the $C^{14}(p,n)N^{14}$ reaction. Five neutron emitting resonances were observed in this region with measured energies and widths which agree with those of other workers. Examination of ground state γ-rays

indicated that they are weak and nonresonant in the region from 2.2 to 3.0 Mev. In addition, strong cascade γ-rays of energies 5.3 and 7.2 Mev were observed at a proton energy of 2.49 Mev, with a maximum cross section of about 0.4 millibarns. If these γ-rays correspond to a known resonance at 2.46 Mev, their cross section leads to a partial radiation width of the order of the Weisskopf limit for El radiation. An alternative explanation is the existence of a single-particle proton state at 2.49 Mev.

Microfilm $2.00; Xerox $3.60. 63 pages.

GAMMA-GAMMA ANGULAR CORRELATION FOLLOWING THE DECAY OF Eu^{152} AND As^{77}.

(L. C. Card No. Mic 59-4949)

Robert Wilson Lide, Ph.D.
University of Michigan, 1959

Gamma-gamma angular correlation is the method of determining the spins of the excited states of atomic nuclei by measuring the relative angles of emission of cascade gamma-rays. The determination of the spins of nuclear states is an important check on the predictions of two recent models of the nucleus, namely the shell model and the unified model.

For the present investigation, scintillation detectors were used with a fast-slow coincidence circuit. A short resolving time was obtained by means of the fast circuit. Pulse-height selectors in the slow circuit permitted the choice of the cascade to be studied.

Directional correlation measurements were made on eight gamma-gamma cascades following the decay of Eu^{152}, and on one gamma-gamma cascade following the decay of As^{77}. The study of Eu^{152} is of particular interest because it decays both to Gd^{152}, which exhibits level spacings characteristic of collective vibrations about a spherical equilibrium shape, and also to Sm^{152}, which exhibits level spacings characteristic of the rotation of a spheroidal nucleus.

The gamma-gamma directional correlations of the 245-kev - 122-kev, 969-kev - 122-kev, 1118-kev - 122-kev, 872-kev - 245-kev, 1170-kev - 245-kev, 1416-kev - 122-kev cascades in Sm^{152} were measured. The spins of Sm^{152} were found to be 0, 2, 4, 2, 3, for the ground, 122-kev, 367-kev, 1092-kev, and 1240-kev levels, respectively. If the 1170-kev and 1416-kev gamma-rays originate from the same level, this level must have a spin of 3. If they originate from different levels, then the 1416-kev gamma-ray could originate from a spin 2 level. An analysis of the correlation functions showed the 245-kev gamma-ray to be pure quadrupole; the 872-kev gamma-ray to be 98% quadrupole, 2% dipole; the 969-kev gamma-ray to be 98% quadrupole, 2% dipole; the 1118-kev gamma-ray to be 99.8% quadrupole, 0.2% dipole; the 1170-kev gamma-ray 98% quadrupole, 2% dipole. If the 1416-kev gamma-ray originates from a spin 2 level, it must be 99.4% dipole, 0.6% quadrupole; if it originates from a spin 3 level, it must be 85% dipole, 15% quadrupole. The levels at 122 kev and 367 kev are interpreted in terms of the unified model as belonging to the ground state rotational band. The levels at 1092 kev and 1240 kev are interpreted as being the first two members of a rotational band associated with a one-phonon gamma-type shape vibration. The interpretation of the level or levels near 1538 kev is not clear.

In Gd^{152} the directional correlations of the 782-kev - 345-kev and 412-kev - 345-kev gamma-ray cascades were measured. The spin of the 1127-kev energy level was found to be 3, and the 782-kev gamma-ray was found to be pure dipole. This is consistent with the interpretation of the 1127-kev level as being a one-phonon shape vibration of the octupole type about a spherical equilibrium shape. A spin of 1, 2, or 3 for the 757-kev energy level would not be inconsistent with the data. For any of these cases, the 412-kev gamma-ray must be mostly dipole, the quadrupole content must be less than 15%. This mixing ratio is not consistent with what is to be expected on the basis of the unified model for shape vibrations about a spherical shape.

The directional correlation of the 276-kev - 246-kev gamma-ray cascade in Se^{77} was measured. The experimental correlation is consistent with a 1/2, 3/2, 1/2 spin sequence, a 1/2, 3/2, 3/2 spin sequence, or a 1/2, 5/2, 3/2 spin sequence for the ground, 246-kev, and 522-kev energy levels of Se^{77}. The possible spin assignments are discussed in terms of the shell model of the nucleus.

Microfilm $2.65; Xerox $9.20. 202 pages.

RADIATIVE PROTON CAPTURE IN O^{18}.

(L. C. Card No. Mic 59-4731)

John William Nelson, Ph.D.
The University of Texas, 1959

Supervisor: Professor Emmett L. Hudspeth

The excitation function for proton capture in O^{18} was observed at 0 degrees with a 3" x 3" NaI crystal. Bombarding energies were determined through the use of an analyzing magnet and proton resonance gaussmeter. Fourteen resonances were found for proton energies ranging from 1.6 to 3.0 Mev as well as indications for other weaker resonances. These resonances correspond to levels in F^{19} with excitation energies between 9.5 and 10.8 Mev. A slow coincidence technique was employed to investigate the gamma decay schemes for seven levels ranging in proton energy from 630 to 2260 kev. Quantitative and qualitative conclusions are drawn regarding the decay of these levels to the ground state triplet and the first excited triplet of F^{19}.

Microfilm $2.00; Xerox $4.20. 79 pages.

HIGHER RESONANCES IN PION NUCLEON INTERACTIONS.

(L. C. Card No. Mic 59-5308)

Ronald Frank Peierls, Ph.D.
Cornell University, 1959

Experimental results in the last few years have indicated the existence, for pion scattering and photoproduction,

of well defined peaks in the cross sections as a function of energy. In view of the great success of the phenomenological description of the 33 resonance an attempt is made to fit the observed data in terms of two new resonant states of the pion nucleon system. It seems possible to get quite good agreement on the basis of a D3/2 level in the I = 1/2 state at 600 Mev pion kinetic energy, and an F5/2 level in the same isotopic spin state at 950 Mev. The information comes mainly from the photoproduction angular distributions and polarization results. A qualitative model is then proposed to explain the occurrence of these levels as being due to the enhancement effects of the 33 resonance in two-meson final states. The correct angular momenta and parities are easily predicted and the energy dependence is in approximate agreement. However, there seems to be some further assumption necessary to explain the isotopic spin. Finally, the connection between the various reactions in the neighborhood of a resonance is investigated in terms of dispersion relations and unitarity.

Microfilm $2.00; Xerox $5.00. 96 pages.

ABSOLUTE EXCITATION FUNCTION FOR THE REACTION $Na^{23}(n,p)Ne^{23}$

(L. C. Card No. Mic 59-4756)

Claude Finley Williamson, Ph.D.
The University of Texas, 1959

Supervisor: Professor Emmett L. Hudspeth

The absolute excitation function for the reaction $Na^{23}(n,p)Ne^{23}$ has been measured over the neutron energy range from 4.8 Mev to 8.2 Mev with an absolute accuracy of $\pm$ 25 per cent and with relative accuracy of $\pm$ 10 per cent or better. The energy resolution was about $\pm$ 63 kev over the entire range. Neutrons for the excitation were obtained from the $H^2(d,n)He^3$ and $N^{14}(d,)O^{15}$ reactions.

The excitation function shows a monotonically increasing trend over the entire range studied. The cross section rises from about 1 millibarn at the lowest energy used to about 120 millibarns at the highest energy. A reasonably good absolute fit to the trend of the cross section is obtained from a calculation based on the Weisskopf-Ewing statistical theory.

The excitation function also shows resonant structure over the entire range studied. The observed resonances are considerably wider than the neutron energy spread, and probably encompass many levels of the Na^{24} compound nucleus. No available theory adequately accounts for this structure.

Considerable attention is also devoted in the appendices to the techniques of calculation of the cross sections and to the corrections which must be applied to the data.

Microfilm $2.00; Xerox $4.00. 73 pages.

PHYSICS, SOLID STATE

MEASUREMENT OF THE GALVANOMAGNETIC EFFECTS IN PURE TELLURIUM.

(L. C. Card No. Mic 59-4654)

Harold Roth, Ph.D.
University of Pennsylvania, 1959

Supervisor: Park H. Miller, Jr.

The study of the galvanomagnetic effects in semiconductors has been one of the most active branches of solid state physics for many years. However it was not until recent years with the advent of new methods of band calculations and many-valley theories of transport properties, that this field was able to yield results of fundamental significance. Coincident with the development of new theoretical procedures came new, more powerful experimental techniques, e.g. cyclotron resonance, for investigating band structures in solids. When such techniques are inapplicable, as in the case of tellurium, galvanomagnetic measurements can be relied on as a capable tool.

The major deterrent to a full investigation of the galvanomagnetic effects in tellurium has been the singular absence of large, high quality, single crystals on which measurements could be performed. Recently, a few exceptionally fine, very pure crystals have been grown in this country by the Czochralski technique at the Honeywell Research Laboratories. The bulk of the results of this dissertation is based upon an extended series of experiments which have been performed on samples from this source.

It is determined that the electrical behavior of pure tellurium is characterized by an anisotropy in the resistivity, as well as in the Hall effect and magnetoresistance. The tensors describing these galvanomagnetic effects are restricted in form by the symmetry properties of the crystal and by the Onsager reciprocal relations. A phenomenological analysis is carried out to relate the measured electric field and current in a particular sample, in an arbitrary magnetic field, to the galvanomagnetic coefficients. It is found to be convenient to prepare three differently oriented specimens in order to measure all of the coefficients to second order in the magnetic field.

The extreme fragility of tellurium required the development of new techniques for cutting the crystal into oriented specimens, and for attaching contacts which would yield reliable and reproducible data over a range from liquid nitrogen temperature to above room temperature. Each sample had at least a 2 mm square cross section, and was etched in CP-4 to minimize effects due to surface conduction. Experimental apparatus was designed and built to properly carry out a complete determination of the galvanomagnetic coefficients.

The values of the galvanomagnetic coefficients as measured at 5000 gauss, are given in the temperature range from 78^0K to 303^0K. The magnetic field dependence of the coefficients, at the two extreme temperatures used in the investigation, is shown up to fields of 12,000 gauss.

The results are discussed in terms of a many-valley ellipsoidal model. At 303^0K the specimens are well into the intrinsic range where electrons dominate the

conduction processes because of their higher mobility. The measurements at this temperature yield two distinct resistivities, equality of the Hall coefficients and zero longitudinal magnetoresistances. This indicates that a simple band model, consisting of one ellipsoid of revolution oriented along the c-axis, is sufficient to describe the conduction band in tellurium.

At 78°K the specimens are extrinsic and p-type (extrinsic n-type tellurium has never been observed) so that the properties of the valence band are measured. Two distinct resistivities and two Hall coefficients are found, as well as non-zero longitudinal magnetoresistances. A simple valence band, described by the most general six-valley ellipsoidal model which could exist in a crystal with the symmetry properties of tellurium, is found to be inadequate to explain the experimental results. A second, overlapping valence band with high mobility holes is postulated and various results consistent with this view are enumerated.

Microfilm $2.00; Xerox $7.00. 149 pages.

PHYSIOLOGY

THE EFFECTS OF AZIDE, URETHAN, ARSENITE AND FLUORIDE ON GROWTH, GLUCOSE UTILIZATION AND PROTEIN UTILIZATION IN STRAIN L CELLS.

(L. C. Card No. Mic 59-4373)

Lloyd Melvin Elrod, Ph.D.
The University of Nebraska, 1959

Adviser: D. M. Pace

Glucose and total protein metabolism in strain L (NCTC #929 clone) cells were determined by measuring utilization from a medium containing 40 per cent horse serum, 40 per cent Earle's balanced salt solution and 20 per cent of 1:1 chicken embryo extract. The effect of added inhibitors - sodium fluoride, sodium azide, sodium arsenite and urethan - upon the utilization was also determined. Glucose values were ascertained by using the Somogyi method (copper sulfate complex) and confirmed by a glucose oxidase enzymatic reagent. Total protein was measured by the Biuret reaction and confirmed by measuring precipitated protein after adding Tsuchiya's reagent.

For the experiments, approximately one million cells were placed in Carrel flasks containing 1 ml. of medium. After two days, when considerable growth had occurred, the medium was changed. Inhibitor was added to test flasks at this time and all cultures maintained for three more days, at which time cells were examined and counted and glucose and protein utilization determined.

The culture population in control cultures reached 3.17 million per ml., on the average. The cells utilized .99 mg. of glucose per ml. of medium and 4.0 mg. of protein per ml. of medium.

In the test flasks sodium fluoride (10^{-2} M), sodium arsenite (10^{-4} M and 10^{-5} M) and urethan (10^{-3} M) inhibited glucose uptake by 28, 23 and 8 per cent respectively, but azide had no effect. Sodium azide (10^{-3} M) inhibited protein uptake by 92 per cent. Sodium fluoride (10^{-3} M) inhibited protein uptake by 39 per cent. Sodium arsenite and urethan accelerated protein uptake in all concentrations, including those which at 3 days proved lethal to the cells.

Death of the cells occurred in sodium fluoride (10^{-2} M), sodium azide (10^{-3} M) and sodium arsenite (10^{-4} M). Although 10^{-1} M urethan killed the cells a concentration of 10^{-2} M had little effect. Fluoride (10^{-3} M), azide (10^{-4} M) and arsenite (10^{-5} M) decreased cell numbers by 24, 63 and 81 per cent, respectively.

All the inhibitors except azide produced a lowered mitotic index. Fluoride and urethan exerted the greatest effect and stopped division in prophase.

Multinucleate forms appeared in 4 per cent of the control cells. Azide increased the percentage and urethan and fluoride reduced the percentage of these forms.

Giant uninucleate and multinucleate cells were observed in all cultures except those exposed to fluoride (10^{-2} M) where only multinucleate giant forms were observed. It is suggested that these forms arise by nuclear division without cytoplasmic division.

The evidence indicates that strain L cells retain the morphology of malignant cells. The presence of some of the enzymes of the Embden-Meyerhof metabolic scheme is suggested by inhibitor studies. The evidence further suggests the possibility of the presence of an alternate pathway of glycolysis.

Microfilm $2.00; Xerox $5.60. 115 pages.

FACTORS INFLUENCING THE FOOD INTAKE OF A POIKILOTHERMIC VERTEBRATE, THE TOAD, BUFO WOODHOUSEI FOWLERI.

(L. C. Card No. Mic 59-4629)

Nellie R. Harris, Ph.D.
University of Pennsylvania, 1959

Supervisor: John R. Brobeck

Experimental work has suggested that, in mammals, the intake of food is a regulated activity under the neural control of the hypothalamus. Although a few studies mentioning feeding in poikilothermic vertebrates have indicated that food intake varies with the sex and the age of the animal and with the season of the year, it had not been previously established that the food intake of an adult poikilothermic vertebrate showed variations in response to temporary changes in the temperature of the external environment, when other environmental variables were controlled.

This paper reports a quantitative study of food intake of the toad, Bufo woodhousei fowleri. Adult toads of both sexes were maintained at constant temperature and with a constant duration of lighting throughout the year. For 24 hr. intervals in each season of the year, the food intake of individual toads was measured at various temperatures between 45°F. and 82°F. The data show that food intake varies directly with short term changes in ambient temperature, when the food offered is live mealworms at the same ambient temperature.

A multiple regression of food intake of male toads on temperature, weight of the animal, and concurrent changes in water content was calculated and proved significant at the 1% level.

It was concluded that this poikilothermic vertebrate varies the quantity of live food ingested directly with the environmental temperature in the range studied, when other factors influencing food intake are held at constant levels. Microfilm $2.00; Xerox $3.00. 58 pages.

SKIN TEMPERATURE CHANGES ACCOMPANYING TEMPERATURE SENSATIONS.

(L. C. Card No. Mic 59-4630)

Edwin Hendler, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. James D. Hardy

In order to study the physiological mechanisms of temperature sensation, the forehead area of subjects was exposed to controlled heating while the skin temperature was radiometrically measured and recorded. Continuous exposure to variations in far infrared radiation produced temperature sensations which could best be correlated with rates of change of skin temperature. Warmth threshold was accompanied by a rate of rise of skin temperature of 0.001° C./sec.; cool threshold was accompanied by a rate of fall of skin temperature of 0.005 - 0.006° C./sec. Reports of sensation continued to be given when no changes in skin temperature were measured, and such reports tended to be repetitions of the immediately preceding ones. Small, rapid fluctuations in skin temperature, exceeding the rates of rise and fall just given, evoked no reports of sensation. It was postulated that the temperature changes involved were confined to the most superficial layers of the skin, and therefore did not stimulate cutaneous temperature receptors. The same sequence of sensation reports resulted from preliminarily heating up or cooling down the skin, and then allowing it to spontaneously return to its normal temperature level. Cool sensations accompanying rapidly rising skin temperature change rates were believed to be due to simultaneous inhibition of warmth receptors and excitation of cold receptors. Linear increases in skin temperature, extending much beyond the usual time required for adaptation to the changes in skin temperature produced, were accompanied by continued warmth sensation. Repeated stimulation of phasic discharge activity in warmth receptors was proposed as the cause for this sensation. Exposure of blackened and unblackened forehead skin to various pulse duration - intensity combinations of near infrared radiation sufficient to evoke threshold warmth sensation permitted intracutaneous temperature changes to be calculated. All such changes producing a threshold warmth sensation caused a temperature rise of about 0.02° C. at a depth of 150 - 200 μ below the skin surface.

Exposure of the skin to free-field, 3 cm. microwave radiation produced initial changes in the skin temperature compatible with primary heating of the tissues by the absorbed energy. Response times to onset and offset of stimuli were characterized by their variability. Persistence of warmth sensation after cessation of irradiation was a consistent finding. Stimulation of warmth receptors by slowly dissipated heat retained in the tissues was believed responsible.

Analysis of the above findings in terms of known temperature receptor discharge activity was made on the basis of change in temperature at the receptor level, as indicated above. In order to explain the observations made, neither the temporal nor the spatial aspects of the temperature change were required. Only a very small change in the phasic discharge activity of any one sensory unit was postulated as being necessary for a threshold temperature sensation.

Microfilm $2.50; Xerox $8.80. 191 pages.

STUDIES ON THE HEPARIN-INDUCED LIPEMIA CLEARING FACTOR AND ITS INHIBITOR.

(L. C. Card No. Mic 59-4114)

Charlotte Hollett, Ph.D.
Vanderbilt University, 1959

Supervisor: Dr. H. C. Meng

Intravenous administration of heparin has been shown to abolish alimentary lipemia. Plasma obtained following an injection of heparin (post-heparin plasma) contained an active principle, the lipemia clearing factor. Post-heparin plasma can be used in an in vitro system to reduce the turbidity of neutral fat emulsion, lipemic serum or chyle. The clearing reaction is accompanied by hydrolysis of the triglyceride with the production of unesterified fatty acids and glycerol.

The clearing activity of post-heparin plasma has been found to be proportional to the heparin dosage up to 0.15/kg. Larger doses of heparin serve only to prolong the presence of clearing factor in the blood and do not increase the circulating levels.

The anticoagulant action of heparin is demonstrable both in vivo and in vitro, whereas the anti-lipemic action was observed only after intravenous administration of heparin. No direct parallelism was found to exist between the anti-lipemic and anticoagulant actions of heparin. Clearing factor can be produced by heparin dosages which are too small to be reflected in the coagulability of the blood. This effect is only transient and to maintain the presence of clearing factor in the blood for any appreciable time, a heparin dose of the order of that which prolongs coagulation is required.

A comparison of the lipolytic activities of pancreatic lipase and the heparin-induced clearing factor have shown them to possess widely different properties in their

response to a number of enzyme inhibitors and other chemical agents.

A procedure has been developed for the purification of the lipemia clearing factor from post-heparin plasma. By this method the specific activity was increased from 0.031 units/mg protein to 70 units/mg protein, with an overall yield of 57 per cent. The purified clearing factor required pre-heparin plasma or serum albumin to serve as a fatty acid acceptor in the in vitro lipolytic system.

Clearing factor has been shown to be present in the euglobulin fraction of plasma and in an electrical field migrates as a beta-globulin. In addition to protein, it contains a carbohydrate component, a protein-bound hexose, which was identified as the amino sugar, glucosamine.

Kinetic studies of the clearing reaction have shown that clearing factor does not obey the Michaelis-Menten formulation for an enzyme catalyzed reaction. This may be due to several factors: (a) the particle size of the substrate, (b) the presence of emulsifying agents in the fat emulsions used as substrate and (c) the requirement of a fatty acid acceptor in the clearing system.

Clearing factor has been found to possess characteristics of both esterases and lipases, but is identical with neither. It was observed to hydrolyze lower fatty acid esters (e.g. C_{10}) more efficiently than the higher ones. In the hydrolysis of fatty acid esters, the bile salt, sodium taurocholate, produced a stimulating action suggesting that clearing factor behaves as a lipase.

No definitive physiological role can, as yet, be ascribed to clearing factor in the transport of blood lipids.

An inhibitor of the lipemia clearing factor has been isolated from post-heparin plasma. The inhibitor has been purified 2100-fold. It is a glycoprotein composed of 81 per cent protein and 3 per cent glucosamine. In an electrical field it has the mobility of an alpha-globulin.

In an in vitro system, the inhibitor depressed the lipolytic action of both post-heparin plasma and purified clearing factor. In vivo studies suggest that the inhibitor prevents the release and/or production of clearing factor. This hypothesis is based on the evidence that administration of the inhibitor before heparin suppressed the in vitro clearing activity of post-heparin plasma. If clearing factor had been released into the circulation in response to heparin, administration of the inhibitor had no effect on the in vitro clearing activity of the plasma.

Since clearing factor inhibitor is present both in normal fasting plasma and in post-heparin plasma, it is suggested that under physiological conditions a homeostatic mechanism exists between the clearing factor and its inhibitor. Microfilm $2.30; Xerox $8.00. 174 pages.

COMPARATIVE OBSERVATIONS OF THE PHYSIOLOGICAL ACTIVITY OF SPERMATOZOA SUSPENDED IN SODIUM CHLORIDE AND SODIUM PHOSPHATE DILUENTS.

(L. C. Card No. Mic 59-4542)

Nicholas Takateru Nakabayashi, Ph.D.
University of Illinois, 1959

The physiological activity of spermatozoa suspended in sodium chloride and sodium phosphate diluents was examined. The respiratory activity of saline-diluted semen was greater than the semen specimens diluted in phosphate containing buffer. In saline, the initial rate of respiration was maintained without appreciable change throughout the incubation period of 4 hours. In the phosphate diluent, the respiration averaged about one half as much and the rate of oxygen uptake declined somewhat more rapidly.

The tonicity of the diluent influenced the respiratory activity of spermatozoa. In saline diluent, the lowest oxygen consumption occurred when the diluent was hypotonic. However, the activity in isotonic and hypertonic NaCl diluents varied from ejaculate to ejaculate. Of the phosphate ion concentrations tested, the greatest oxygen uptake, though lower than in saline, occurred in the diluent exerting an osmotic pressure of 3.9 atmospheres (approximately 51 to 54% of the osmotic pressure of seminal plasma). The fructose utilization of spermatozoa in both diluents was greatest when the suspension media were isotonic.

Another condition which was found to affect the fructolytic activity of spermatozoa under air was the conformation of the vessels into which the sperm suspensions were placed. The fructose utilized and lactic acid accumulated during the incubation of semen in 9 x 75 mm. test tubes were greater ($P < 0.01$) than in 5 ml. Warburg reaction flasks. The livability of the sperm cells manifested by their motility at the end of a test period was better in specimens diluted in saline than in phosphate buffer.

In order to explain the differences in the fructolytic behavior of bovine spermatozoa in sodium chloride and sodium phosphate diluents, attempts were made to demonstrate the presence of the hexose monophosphate pathway of carbohydrate oxidation. Sonically disintegrated cell-free extracts of spermatozoa were examined for the enzymes, glucose-6-phosphate dehydrogenase and 6-phosphogluconate dehydrogenase, characteristic of this oxidative system. The activity of the enzymes was not detected in glycyl-glycine buffer at pH 7.4.

The addition of pyruvate to saline suspensions of twice-washed, goat epididymal spermatozoa stimulated respiration, during the first hour of incubation, fourfold above the endogenous. The stimulation in the presence of fructose was twofold. In phosphate diluents, pyruvate stimulated respiration approximately twofold, and fructose fourfold. The utilization of pyruvate and fructose in saline was 71.0 and 37.0, and in phosphate diluent 57.6 and 83.1 ug./10^8 cells/hour, respectively, during 4 hours of incubation. Similarly the respiration of twice-washed, bull epididymal spermatozoa was increased above the low endogenous rate when pyruvate or fructose was present. However, the oxygen uptake of bull cells was less than that recorded for the goat cells. Pyruvate and fructose

utilization in saline were 148.9 and 127.4, and in phosphate diluent 111.0 and 132.7 ug./10^8 cells/hour, respectively.

During the course of the observations, some physiological responses of spermatozoa were thought to be associated with the seasons of the year. On further study, summer-collected, washed spermatozoa suspended in fructose-containing diluent utilized significantly ($P < 0.01$) more oxygen and fructose than winter-collected cells treated in a similar manner. The fructose utilized by summer-collected cells suspended in winter (stored) plasma was significantly ($P < 0.05$) more than summer-collected cells in summer plasma. In comparisons of the washed and resuspended spermatozoa collected during the two seasons of the year, summer-collected cells utilized more fructose ($P < 0.01$) and accumulated more lactic acid ($P < 0.05$) than winter-collected cells.

The physiological responses of semen from normal and from epinephrine-treated bulls were compared. No significant difference in the behavior of the sperm cells was observed. Microfilm $2.60; Xerox $9.00. 199 pages.

THE SITES OF THE RENAL TRANSPORT MECHANISMS FOR POTASSIUM, HYDROGEN AND AMMONIUM. THE EFFECT OF IMMOBILE ANIONS UPON THEIR TRANSPORT.

(L. C. Card No. Mic 59-5000)

Lawrence Paul Sullivan, Ph.D.
University of Michigan, 1959

The purpose of this research was to locate the renal tubular sites of the secretory mechanisms for potassium, hydrogen and ammonium and the site of the potassium reabsorptive mechanism. The effect of the immobile anions, thiosulfate, ferrocyanide and phosphate, upon the transport of these cations was also studied.

The technique of stop flow analysis was applied to mongrel dogs. This technique allows the localization of transport mechanisms in specific segments of the renal tubule by analysis of the concentration patterns developed along the length of the nephron during stopped flow. The stopped flow is accomplished by ureteral occlusion following a brief period of osmotic diuresis. The period of stopped flow allows the various transport mechanisms to alter to their maximum ability the concentration of particular substances in the tubular fluid in contact with them. Following a 3-7 minute occlusion, the concentration patterns oriented along the column of fluid moving out of the nephron are caught and segmented into an ordered array by the collection of small serial urine samples from an ureteral catheter.

The potassium transport mechanisms were studied in untreated dogs, in dogs adapted to high infusion rates of potassium by prior feeding of KCl for a period of time, and in dogs treated in this manner and additionally infused with the immobile anions, thiosulfate and ferrocyanide. The potassium, hydrogen and ammonium transport mechanisms were studied in acidotic dogs before and during infusions of phosphate. Titratable acid was measured as an index of hydrogen ion secretion.

Data were obtained that indicate that potassium, hydrogen and ammonium secretion occurs only in a very distal area of the nephron, presumably the collecting ducts. Potassium reabsorption also occurs in a distal area at a site immediately proximal to the secretory site. Infusions of the immobile anions, thiosulfate, ferrocyanide and phosphate, alter the stop flow concentration patterns so that a pseudo-secretion of potassium, hydrogen and ammonium appears to take place throughout the distal tubule and to be coextensive with distal sodium reabsorption. No clear indication of potassium reabsorption is evident under these circumstances. It is suggested that these anions, because of the impermeability of the distal tubule to them and because of their negative charge attract hydrogen and potassium into the tubular lumen as sodium is reabsorbed. In effect, an abnormal exchange mechanism is created at a site proximal to that where active secretion of hydrogen and potassium occurs.

Microfilm $2.00; Xerox $3.80. 67 pages.

RESPIRATION AND WATER LOSS AT THE HIGHER TEMPERATURES IN THE DESERT IGUANA, DIPSOSAURUS DORSALIS.

(L. C. Card No. Mic 59-4322)

James Roderick Templeton, Ph.D.
University of Oregon, 1959

Adviser: B. T. Scheer

The desert iguana, found in desert regions of the southwestern United States, maintains its activity body temperature between 34-45° C. by maneuvering in and out of different thermal levels. It can also dissipate body heat by the evaporation of water from its respiratory tract. In times of emergencies or at body temperatures over 43° C. panting occurs.

This study is concerned with determining the cooling effect of respiration by studying the rate and pattern of respiration, water loss, and the cloacal and cranial temperatures at the higher environmental temperatures.

The animals were placed inside a watertight, ventilated glass tube enclosed within a constant temperature, circulating water bath. Dry air, heated to the water temperature, ventilated the glass tube. A pneumograph, tambour, and electric kymograph recorded the rate and pattern of respiration. Water lost was collected by the dessicant, silica gel. Deep cloacal temperatures for the above experiments were taken with a differential thermocouple accurate to $\pm 0.2°$ C. Water and air temperatures were always taken with mercury thermometers calibrated in tenths of a degree Centigrade. To determine the effect of respiratory cooling in terms of body temperature, body temperatures taken in dry air were compared with those taken in air of the same temperature but saturated with water vapor. Some experiments were performed with the animals wrapped and thereby insulated with cellulose-cotton batting. Bead thermistors accurate to $\pm 0.1°$ C. were used to take the cloacal and cranial temperatures.

The rate of respiration increased and the pattern became less uniform as the temperature increased. At 32° C. the pattern was largely diphasic, but as the temperature increased the monophasic pattern became more evident. Sometimes panting began abruptly with slow deep

respirations; at other times rapid shallow respirations superimposed upon slower deep respirations became more dominant until the respirations were completely shallow and rapid. Water loss measured in mgs./gms. body wt./ hr. increased in logarithmic fashion with temperature. At 32° C. the water loss was 0.86 mgs.; at 36° C., 1.16 mgs.; at 40° C., 2.08 mgs.; and at 44° C. the amount was 3.64 mgs. When these figures are correlated with oxygen consumption studies done by Dawson, the water loss appears sufficient only to dissipate metabolic heat.

Body temperatures from animals in dry air were within 0.1 degree of water temperatures below 40° C. At water temperatures of 44° C., body temperatures of iguanas in dry air were within 0.2° C. of the water temperature, in humid air as high as 0.4° C., above and in humid air and insulated, the body temperature was as high as 0.7° C. above. At 46° C. water temperature, the body temperatures in dry air were as high as 0.4° C. above, in humid air 1.0° C. and in humid air and insulated 1.4° C. above the water temperature. Cranial and cloacal temperatures remained essentially the same indicating that no local cooling of the brain occurs due to evaporation of water in the buccal cavity.

From these data it seems that respiratory cooling does not serve to lower the body temperature below that of the environment, but rather to dissipate metabolic heat. With increasing environmental temperature the oxygen consumption and thereby the metabolic heat are increased. To dissipate the heat, water loss must be increased accordingly. If not dissipated, the additive effect of this heat is effective in raising the body temperature to the lethal point or at least in decreasing the exposure time for the animal to remain in the higher thermal levels.

Microfilm $2.00; Xerox $3.60. 62 pages.

THE CARCINOSTATIC EFFECT OF EXTRACTS PREPARED FROM COW OVARIES.

(L. C. Card No. Mic 59-4670)

Thomas Robert Tosteson, Ph.D.
University of Pennsylvania, 1959

Supervisor: L. V. Heilbrunn

It has been suggested by other workers that the rate of cell division, indeed cell division itself, may be due to a process dependent on the balance of heparin-like anticoagulant substances and their antagonists. Aqueous extracts were made of cow ovaries and tested against the growth and lethality of an ascites tumor implanted in mice. The antimitotic action of such extracts on marine eggs has been reported previously.

The control animals inoculated with 1.5×10^6 tumor cells, in 12 separate groups, totaled 285. The mean survival time of a control group was 14.9 ± 0.8 days. Tumorous animals treated with the aqueous extract showed a survival of 17.4% at the end of 30 days. Animals treated with the 1 Molar NaCl extract showed a survival of 35.5% at the end of 30 days. Animals treated with an acid extract showed a survival of 21.6%. All three of these figures are significantly different from the control. An inactive crude preparation was prepared by phenol partition. This crude material was purified by the removal of loosely bound lipids and nucleic acids. After purification the preparation had a carcinostatic effect. The animals treated with the purified preparation exhibited a survival of 25.7% at the end of 30 days.

The mean survival time of a group of treated animals was not significantly different from the mean survival time of the control group. The distribution of the daily lethality of the tumor was shifted in the case of the extract-treated animals. This change generally was to enhance the lethality of the tumor during the early days of tumor growth. An explanation of the enhancement of the early lethality of the tumor is discussed in terms of the toxicity of the products of disrupted tumor cells.

The carcinostatic effect of a variety of types of extracts of cow ovaries has been demonstrated. These extracts have been shown to have an antimitotic effect on marine eggs. It is suggested that these effects stem from the same principle.

Microfilm $2.00; Xerox $3.00. 30 pages.

AN INVESTIGATION OF THE LOCALIZATION OF TROPHIC HORMONES FROM THE ANTERIOR PITUITARY LOBE WITH SPECIAL EMPHASIS ON ADRENOCORTICOTROPHIC HORMONE.

(L. C. Card No. Mic 59-3533)

Frode Ulvedal, Ph.D.
Emory University, 1959

A means for the separation of intracellular particles (acidophilic granules, heavy and light mitochondria and microsomes, in addition to supernatant and nuclei-debris) from the anterior pituitary cells was developed. Each of the fractions were analyzed by chemical and enzymatic methods to determine the completeness of separation from contaminating particles, before each fraction was assayed for hormone content. The fractions were assayed by a three-dose response method for TSH, STH, ACTH, LH, and FSH. The results show that TSH is sharply located in the mitochondrial fraction. LH and STH are found in the acidophilic granules, while FSH was distributed over several fractions but with the highest concentration in the microsomal fraction. ACTH was found in the mitochondria, microsomes, and supernatant depending on the method of assay adopted. The eosinophil response located the ACTH in the mitochondria; the method of assay utilizing the adrenal ascorbic acid depletion resulted in the localization of ACTH in the microsomes, while Saffran's in vitro method indicated that ACTH is in the supernatant. The predominant activity appeared in the indicated fractions, but there was scattered activity over several fractions.

Each fraction was then subjected to acid treatment which destroyed the activity of TSH and FSH, but had no effect on the activity of STH and LH. There is some indication that FSH activity as seen by the ovarian response is different from the FSH which causes response in testicular tissue. Acid treatment of the fractions potentiates the ACTH activity indicating that a small active molecule has been liberated from a carrier

protein or the activation of a relatively inactive hormone. Alkaline treatment of the fraction seems to destroy hormone activity. A correlation has been made between the location of hormones by histological and ultracentrifugal methods. Microfilm $2.00; Xerox $5.80. 118 pages.

PHYSIOLOGICAL ANALYSIS OF A VIRUS DISEASE -- PSEUDORABIES VIRUS IN SYMPATHETIC GANGLIA.

(L. C. Card No. Mic 59-4682)

Jacob Zabara, Ph.D.
University of Pennsylvania, 1959

Supervisor: John Dempsher

The possibility was explored that the virus infection was interfering with the normal function of an inhibitory system having its origin in the central nervous system (CNS) and exerting its effects upon the presynaptic nerve terminals.

Pseudorabies virus was injected into the right eye of rats and 48-72 hours later there was a functional derangement in the superior cervical ganglion. Derangement takes the form of spontaneous impulses (virus-induced activity) discharged simultaneously and synchronously over preganglionic and postganglionic nerves.

The presence of an inhibitory system in these ganglia was considered on the basis of several observations which involved interruption of the nerve pathway between the CNS and the ganglion. Interruption by cocaine or nerve section in early infections resulted in the onset of activity if originally absent or increase of activity if already present. In late infections, with a considerable amount of activity already present, there was little or no increase in the activity. Following these experiments, the possibility was explored that the inhibitory system mediated its effects through chemical substances such as gamma aminobutyric acid, adrenaline and noradrenaline. Thiosemicarbazide and TM 10 which are known to interfere with the synthesis of gamma aminobutyric acid and catechol amines respectively were also tested for their effects. The results were that gamma aminobutyric acid, adrenaline and noradrenaline depressed the activity whereas thiosemicarbazide and TM 10 increased the activity. Also, these chemicals were found to act upon the nerve endings. These results are therefore in accord with the view that gamma aminobutyric acid, adrenaline and noradrenaline might be substances mediating inhibition in the ganglion.

Next, an investigation was carried out in order to determine how the excitatory and inhibitory systems were interrelated at the presynaptic nerve terminals. It was found that one possibility was that they were interrelated through an electrical event in the presynaptic nerve terminals — a slow potential. A slow potential was observed which had its maximum amplitude at the ganglion and which decremented along the preganglionic trunk away from the ganglion. Furthermore, the presynaptic slow potential may be present after all electrical activity has vanished from the postsynaptic cell because of the virus infection having destroyed these postsynaptic cells. The view that the excitatory and inhibitory systems were interrelated through the slow potential apparently arising in the presynaptic nerve terminals was supported by the application of chemical substances to ganglia. Physostigmine and acetylcholine greatly increased the slow potentials and curare decreased them. Gamma aminobutyric acid, adrenaline and noradrenaline, possible inhibitory substances, decreased the slow potentials.

In summary, it appeared reasonable that the acetylcholine causing the virus-induced activity was released spontaneously because the virus infection interfered with an inhibitory system. This inhibitory system has its origin in the CNS and exerts its actions on the presynpatic nerve terminals.

During this investigation a slow potential was observed which apparently originated in the presynaptic nerve terminals. In order to explain the virus-induced derangement, the following concept of conduction and transmission in autonomic ganglia is adopted as a working hypothesis. A spike is conducted from the CNS to the presynaptic nerve terminals where it causes the release of acetylcholine which produces a depolarization that may be recorded as a slow potential. This presynaptic slow potential induces in the postsynaptic neuron a corresponding slow potential which causes the discharge of a spike or spikes conducted along the postsynaptic axon. Inhibition and excitation apparently interact in the presynaptic nerve terminals through the presynaptic slow potential.
Microfilm $2.00; Xerox $5.20. 102 pages.

POLITICAL SCIENCE, GENERAL

FORMULATION OF THE PHILIPPINE COMMUNITY DEVELOPMENT PROGRAM.

(L. C. Card No. Mic 59-4872)

Jose Veloso Abueva, Ph. D.
University of Michigan, 1959

Recognition of the problem of rural improvement in the Philippines to the point of intensified action was the result of gradual historical development. In the post-war period, a growing barrio (rural village-community) improvement movement was climaxed by the dramatic rise of Ramon Magsaysay to the presidency. While Magsaysay's recognition of the rural problem was not without precedent, it differed from that of his predecessors in the degree of its emphasis, and in the opportunities, leadership, ideas and methods, facilities, and funds available for its realization.

To help bring about a coordinated and balanced approach to rural development, the Magsaysay Administration launched the Philippine Community Development Program early in 1956. The formulation of the Program took about two years, and involved a host of Filipino officials and agencies, U.S. foreign aid agencies, the U.S. Congress, the United Nations Technical Assistance Administration, private American citizens, and a Chinese leader of the mass education movement.

This dissertation is a case study of the conditions and processes of formulating the Philippine Community Development Program. As background, it describes the rural Philippines through the perceptions of scholars and of the Program planners, and analyzes Magsaysay's campaign, election, and first year in office. It then attempts: (1) to reconstruct the interaction of a number of individuals and groups that tried to influence the nature of the Program, (2) to recapture the setting of their activities, and (3) to provide insight into their motivation. The study points up the long, tortuous, and often vexing process of translating broad political and social objectives into meaningful public policy and a workable program of action. It reveals the ways in which the Chief Executive and his young lieutenant, a 27-year old lawyer named Ramon P. Binamira, grew in political awareness and administrative perception. The study also illustrates the workings of the economic aid and technical assistance program of the United States in the Philippines, and some of the ways by which the United Nations organization assists countries like the Philippines in promoting community development.

Responsibility for the administration of the Philippine Community Development Program was assumed by the Presidential Assistant on Community Development in January 1956. Prior to the PACD, an inter-departmental Community Development Planning Council (with three non-governmental members) was created by Magsaysay to plan and carry out a national program of community development. One of the main foci of the study is Binamira, who played a strategic role as CDPC executive secretary and was appointed presidential assistant by Magsaysay. A substantial part of the entire study is devoted to the operating characteristics and weaknesses of the CDPC. The striking discrepancies between the ideal and the actual organization and performance of the CDPC are described and analyzed.

A multiplicity of individuals and groups channeled their efforts more or less persistently to influence the philosophy, the administrative organization, the methods and techniques, and the leadership of the Program. Among the more evident motives that prompted their actions were organization policies and objectives, idealistic goals, ideological preferences, professional values, political ambitions, social approval and recognition, and the will to survive and advance in both a personal and organizational sense. The goals and interests, and the planning strategy and tactics, of Ramon P. Binamira and of the other major participants in the planning process are highlighted.

Also noted are the influences upon the formulation of the Program of: (1) changes in the planning environment, (2) foreign models of rural development, (3) bureaucrats (Filipino and foreign), (4) U.S. financial aid, and (5) sociological and anthropological approaches to urged social change. Microfilm $9.30; Xerox $33.00. 733 pages.

AN ANALYSIS OF VOTING BEHAVIOR IN OHIO.

(L. C. Card No. Mic 59-4431)

Joe Hoover Bindley, Ph.D.
University of Pittsburgh, 1959

Adviser: A. B. Martin

The purpose of this Ohio study is twofold: (1) to decrease the void in basic knowledge of political information on the Buckeye state; (2) to examine, in so far as is possible, various postulates which have been considered by students of politics. Structurally, the analysis divides as follows: (1) a history of Ohio politics from 1798 to 1924; (2) a detailed analysis of the state's elections for President, United States Senator, and Governor from 1924 to 1956; and (3) a consideration of basic influences in Ohio politics, such as newspapers, party structure, candidates, and ecological patterns. In the latter discussion, questions concerning demographic factors, the role of organized labor, the effect of a large voter turnout, and coat-tail patterns are examined. Questions relating solely to Ohio include an examination of the volatility of the state's politics, split-ticket voting, the role of Cleveland, newspaper significance, pressure groups, and the nature of the party structure.

Materials were accumulated from Ohio histories, election statistics, newspaper accounts of contemporary

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

campaigns, and interviews with county chairmen and newspaper editors.

Limitations, in addition to the 32-year time period, are occasioned by the utilization of voting statistics on a county-wide basis and consideration in detail of only those elections for the offices of President, United States Senator, and Governor. A brief survey of the results of elections for minor state-wide offices is included in the latter section.

The format of the discussion of contemporary period of Ohio elections consists of description illustrated by maps indicating the two-party percentage in each of the counties. The total results for each of the three offices during the 32-year period are summarized by tables and maps.

Succinctly stated, the conclusions of the study are:

(1) Ohio tends to be barometric in national contests; i.e., Ohio voters normally reflect national predispositions in presidential contests.

(2) Ecological voting patterns seem insignificant in Ohio. The potential dominance of the state's politics by Cleveland or any other of the eight metropolitan centers remains unrealized.

(3) At least through 1956, the role of organized labor in Ohio politics has not been too effective.

(4) The size of the turnout in Ohio cannot be asserted as a definite asset to one party or the other.

(5) Coat-tail effects are not too evident in Ohio politics. Historical split-ticket voting practices interfere with logical statistical progressions.

(6) The careers of Donahey, Taft, Bricker, and Lausche in contemporary Ohio politics suggest that the individual candidate is significant to a comprehension of Ohio electoral behavior.

(7) A change in ballot from the party-column form to the office-block arrangement in 1950 produced no appreciable alteration in the traditional independent aspect of Buckeye politics.

(8) The role of the newspaper in Ohio politics is indeterminate. Endorsements are of some value to Republicans, but Democrats have been successful in spite of press opposition.

(9) Pressure groups do not appear to have been directly effective in Ohio political contests. Lobbying activities are beyond the scope of this study.

(10) The Republican party in Ohio is much better organized than its Democratic counterpart.

In the course of the conclusions, the author has pointed out areas where additional study is needed.

Microfilm $3.95. Xerox $13.40. 308 pages.

THE BRAZILIAN MUNICIPIO: THE MYTH OF LOCAL SELF-GOVERNMENT.

(L. C. Card No. Mic 59-4715)

Carr Lowe Donald, Ph.D.
The University of Texas, 1959

Supervisor: J. Lloyd Mecham

This study analyzes certain aspects of the historical and contemporary status of Brazilian local government. It reveals that government on the local level in Brazil is quite distinct from local self-government in the Anglo-American sense of that term. While decentralized governments existed in Portugal and later in Brazil, they did not develop in the same manner as did their North American counterparts. Popular participation in local government was restricted; reduced financial resources limited local government services; and political developments and governmental changes did not become associated with localism. In fact, principally as the result of an unfavorable socio-economic situation, the inevitable and irresistible trend throughout Brazilian history was toward centralism. Many of the effects of this centralist tradition remain in contemporary institutions. They are shown in governmental finance, in functions and in the almost hopeless dependence of local administrations upon state and national governments.

In writing this study the author adopted and used several different approaches. Certain data were analyzed in retrospect. The purpose of the historical material was to resurrect factual information which could assist in describing more adequately contemporary institutional arrangements. It recognizes that contemporary agencies are for the most part products of a continuous historical evolution. Most of this material is treated in a chronological sequence. It is followed with a descriptive and statistical analysis of contemporary material. The statistical data are presented and analyzed in an effort to explain the present nature of governmental organization and operations. Because of the possible inaccuracies of that information, a modified survey method is used to classify local governments. The material for these classifications came from personal observation, wherever possible, and from authoritative secondary sources.

By no means is this the first study of Brazilian local institutions. Brazilians have also concentrated on various aspects of this subject. Some of them have favored a general historical and legal approach. Others have limited their analyses to a characterization of the institutional developments during certain periods. In both of these cases the studies are excessively legal in character. Finally, a very small group of Brazilian students has sought to bridge the gap between legal principles and political reality. As political sociologists, members of this group have placed principal emphasis upon the political and socio-economic conditions which promoted coronelismo, or rule by powerful local patriarchs. Because other situations also existed which tended to destroy patriarchalism on the local level or, at least, weaken it, the colonel theory was not entirely accepted in this study.

As some of the effects of Brazil's oligarchical traditions have been analyzed in those studies, this work concentrates upon one apsect of that tradition. This is the theoretical and practical relationships that have developed between different governmental authorities. By analyzing historical and contemporary institutions, it seeks to determine the adequacy or inadequacy of local responses to local needs, i.e. the extent of local self-government.

For the most part also the Brazilian accounts are non-comparative. This study, on the other hand, seeks to compare Brazilian local government with its American counterparts. Much of this material is incorporated in various parts of the dissertation. A subthesis of the historical material is the unpopularity and political insignificance of localism in that country in contrast to the political importance that decentralization has assumed in the United States.

Data on the geographic and demographic aspects of Brazilian local government are also compared with similar features in American county government. The material presented on finance, functions and inter-governmental relations is also written with American institutions in mind. The purpose of comparing these features of local government in both systems is to indicate the detrimental effects of centralism on local government in Brazil. This centralism has molded popular attitudes, encouraged and assisted the development of a multi-party system and reduced local governments to a completely dependent status. More important, it has tended to alter their status from governments to mere administrative entities.

Microfilm $4.40; Xerox $14.80. 344 pages.

JEAN-PAUL SARTRE AS CRITIC OF POLITICAL IDEOLOGIES.

(L. C. Card No. Mic 59-4918)

Norman Nathaniel Greene, Ph.D.
University of Michigan, 1959

The purpose of this study is an investigation of Sartre's position with regard to the ideologies of Catholicism, liberalism, and Marxism. The term ideology is used to describe a system of beliefs and the philosophical position which these beliefs imply and upon which they depend. Discussion of the doctrines of Catholicism, liberalism, and Marxism has been limited to evoking those parts of each doctrine, including assumptions implicit within them, which are attacked by Sartre. Preference has been given to orthodox interpretations of the doctrines, since Sartre's criticisms are addressed to their ideological aspects and not the manner in which they may have been formulated by individual thinkers.

Sartre has never made a systematic statement of his political theory, and thus the evidence for his views is drawn from the entire body of his work. The criticisms of political ideologies contained in the novels, plays, and essays can only be understood in the light of Sartre's theory of human nature and ethics; this subject is accordingly treated in the first chapter. The presentation of Sartre's criticisms of Catholicism, liberalism, and Marxism is, in each case, followed by a consideration of the criticisms of Sartre by adherents of these doctrines. Evaluation of the relative merits of the positions of Sartre and his opponents is restricted to the terms of the discussions between them.

The burden of Sartre's critique is that all these ideologies attempt to find certainties in the realm of the historical which are in fact impossible of attainment. This attempt is for Sartre at once a philosophical error and an evidence of "bad faith," or an attempt to flee the full implications of human freedom. Sartre, as a critic of political ideologies, thus appears as a systematizer of human existence who insists upon the pragmatic and relative nature of politics.

Microfilm $3.40; Xerox $11.60. 261 pages.

SOVIET SPORTS: A SCHOOL FOR COMMUNISM.

(L. C. Card No. Mic 59-4082)

Henry W. Morton, Ph.D.
Columbia University, 1959

This study describes and analyzes the importance of sports and physical culture in the Soviet Union and the means of control exercised over it by the Communist Party. Sport groups (kollektivy) of which there are 190,000 are found in factories and plants, on the collective farms, in schools and in universities, in the armed forces, and in the secret police. More than twenty million people are members of sport societies and groups and more than twice that number of students receive physical education instruction. There are forty-six recognized sports with competition in each reaching its peak at all-union meets or league championships. Since the war the Soviet Union has actively and successfully campaigned in international competition winning prominence in a variety of sports. Russia has in fact become the sports leader of the world.

The sports system does not revolve independently in its own orbit, unaffected by its own environment. On the contrary, resulting from the all-inclusive nature of the Soviet regime, sport is integrated with and part of the Soviet milieu, and in practice a true reflection of Soviet life. The Party very early recognized the multitudinous uses to which sport could be put and set up a complex governmental machinery to accomplish its aims and allocated large sums of money for physical culture. A gigantic sports program was the consequence, which had the fourfold task of drawing the masses into sport activity, improving their labor productivity and their military preparedness, training the most gifted athletes to establish Soviet supremacy in international competition, and perhaps most fundamental, through sports participation, drawing the masses into Party-controlled political activity. A description and a history of the Soviet sports structure and the levers of Party control will be found in chapters two through six.

Soviet propaganda proudly boasts that unlike sports in bourgeois society, "Our sports are sports of millions of working people, genuinely mass sports;" that Soviet sport victories prove the superiority of the Soviet system of the West; and that sport has contributed significantly to the strengthening of communist mores by developing such moral qualities as honesty, courage, tenacity, conscious discipline, a collective spirit and a will to win.

Soviet assertions, particularly those regarding the true mass nature of Soviet sports and the successful use of sport as a school for communism may be seriously questioned. The Party, by its stress on winning, a policy since the early Thirties, had created a caste system of athletes. Star-sportsmen receive all the attention, money and glory while the sport participant of average potential is often ignored. A mania for records and the allocation of large sums of money for sport achievements has led to undesirable practices. Rampant professionalism, the wooing of athletes to "jump" one sport society for the other, the hiring of athletes for their sport ability and not for the productive capabilities, a general lowering of sport mores which include fixing of games, habitual display of roughness on the playing fields (and at times, "hell raising" off it), and most seriously, preferential treatment of gifted athletes, are all endemic to a system which supports

elitism in sports. These features are discussed in chapters seven and eight.

The study concludes that the growth of sports in the U.S.S.R. and the continuum of the present sports program of gigantic proportions was not the result of a spontaneous movement of popular pressure, but the consequence of Party decision.

Microfilm $3.80; Xerox $12.80. 295 pages.

A COMPARATIVE ANALYSIS BETWEEN THE THAI LABOR LAW AND UNITED STATES LABOR LEGISLATION.

(L. C. Card No. Mic 59-4030)

Sukdi Pasuknirunt, Ph.D.
Indiana University, 1959

Though the title signifies a comparative study between the labor laws of Thailand and the United States, the emphasis has been mainly on the Thai labor law which was enacted in September, 1956, and which was later abrogated by the new Revolutionary Government in October, 1958, on the grounds that the law had created industrial unrest and provided means for Communist subversive activities.

The failure of this law within a relatively short period of its enforcement posed three challenging problems for this study: (1) the appropriateness of a labor law in Thailand while the country was predominantly agricultural; (2) reasons for the differences and similarities between the labor laws of Thailand and the United States; and (3) whether or not Thailand should have a labor law in the future, with modifications designed to produce better results.

The results of this study can be summarized as follows:

(1) There were certain forces pressing for labor legislation, even though Thailand's economy was still in an agricultural stage. They included the growth of population resulting in uneconomical land holdings and forcing certain rural inhabitants to seek non-farm jobs; modern standards of living which encouraged more industrialization and an increase in the number of industrial workers leading to more industrial disputes; the awareness of public authorities of the welfare and well-being of the working class whose sufferings had been due to unhealthy working conditions and to the low level of general wage rates. The idea of having labor legislation for the handling of labor problems, therefore, originated several years before the actual passage of the law in 1956.

(2) There are certain differences and similarities in the labor laws of Thailand and the United States, although it has been said that the former's law was framed along the line of the latter's. The differences seem to have developed from a fundamental difference in political and economic conditions in the two countries. A paternalistic principle, by which the ruler is supposed to be not only a guide but also a director, coupled with an insecure feeling from the dominant role of aliens in her economy, permits the Thai ruling bodies to maintain a firm control on most private affairs. On the contrary, the American economic system has long been based on a principle of "free enterprise" and the advocacy of "less-government intervention" in private business. The result of these two vital differences was that Thailand was willing to accept any provision of American labor laws or international standards so far as it did not diminish the power of the authorities nor worsen her economic security.

(3) The failure of the legal enforcement in Thailand was due principally to (a) mishandling on the part of certain public authorities concerned, (b) the ignorance of workers due to their relatively low level of education, and (c) the lack of wise union leadership which induced them to use the newly obtained rights unwisely and resulted in many industrial disputes and suffering of the workers.

Based upon the foregoing findings a number of suggestions and recommendations are made with a view to securing better results in the event that a new labor law may be re-enacted at some time in the future.

Microfilm $4.50; Xerox $15.00. 349 pages.

NATIONALISM AND FEDERALISM IN NIGERIA.

(L. C. Card No. Mic 59-4586)

Babatunde Abraham Williams, Ph.D.
University of Illinois, 1959

Nigerian nationalism and federalism are closely interlinked as phenomena of Nigerian social and political evolution. As a colonial state, Nigeria was an administrative consolidation of contiguous British territories of divergent ethnic and cultural groups. While some decentralization would have better suited her governance, this proceeded at first on a unitary basis owing to the adopted system of indirect rule.

This administrative system bears on both Nigerian nationalism and federalism. It was most successful in highly traditional and structured societies and least successful where the reverse of this prevailed. This led to differences in the pace and pattern of adaptation to British rule and Western civilization by the constituent ethnic groups with the result that nationalism grew slowly where indirect rule succeeded and fast where it failed or was partially successful. But as indirect rule served the British administration as a common denominator of Nigerian ethnic disparateness, common political institutions and usages were not introduced into these different indigenous cultures. Thus Nigerian divergence persisted and later militated against the building of a nationalist movement. In this context, tribal unions later emerged to augment particular ethnic interests. But as these eventually grew into political parties, tribalism and regionalism became strong socio-psychological complexes from which the various ethnic groups could reach a consensus for nationhood and independence only through a federal constitution.

In this respect, the adoption of indirect rule in Nigeria points to two dilemmas of imperial policy: (1) Should the government of Nigeria be unitary or federal--a unitary constitution was implied by the central government furnished by the imported British bureaucracy which linked the various tribal areas and a federal constitution by the Native Administrations which governed these mainly according to immemorial usage; (2) If unitary or federal, should the Westernized elite supplant the imported British oligarchy or should the Native Authorities be so developed that they could furnish the central government along modern lines.

The Richards Constitution resolved these dilemmas by providing a constitutional link between the Native Administrations and the Central Government and by urging development along federal lines for Nigeria. As it did not advance the constitutional status of Nigeria and as it was drafted without the confidence of the nationalist-intelligentsia

who regarded it an imperial artifice of Pakistanization, it could not provide the consensus necessary for nationalistic goals. It was thus superseded by the quasi-federal Macpherson Constitution which vested the supervisory regional assemblies created by the Richards Constitution with legislative powers and complemented them with executive councils.

As the Macpherson Constitution compromised nationalist forces still divided between a unitary and a federal constitution and closely interlinked the ethnically oriented regional governments and the federal government, ethnic and tribal tensions increased. This led to polarization of political feelings along a North-South axis over a date for independence, and finally disrupted the Macpherson Constitution.

The subsequent Lyttelton Constitution gave Nigeria a truly federal structure and vested the regions with residual powers and greater autonomy. Moreover, it resolved the nationalist dilemma over a unitary and a federal constitution in favor of the latter.

The yet unresolved myriad problems, notably the structure of the federal legislature, federal-regional division of functions and revenue, suffrage, minority rights, the creation of more states, etc., were met in part by the Robertson Constitution of 1957.

The correlation of Nigerian nationalism and federalism suggests certain continuities in Nigerian social and political history and underlines that the future stability of the Nigerian state must rest on an equipoise of ethnic and/or regional forces. But if the true Nigerian nationalists were Dr. Azikiwe and the National Council of Nigeria and the Cameroons, Barrister Awolowo and the Action Group were the genuine federalists to whose schema Nigerian federalism has conformed most in structure.

Microfilm $7.25; Xerox $25.00. 572 pages.

POLITICAL SCIENCE, INTERNATIONAL LAW AND RELATIONS

THE ACCOMPLISHED AMBASSADOR BY CHRISTOPHER VARSEVICIUS AND ITS RELATION TO SIXTEENTH CENTURY POLITICAL WRITINGS WITH A TRANSLATION OF THE TREATISE FROM THE LATIN.

(L. C. Card No. Mic 59-3659)

Robert Leo Ferring, Ph.D.
University of Notre Dame, 1959

The aim of this study is to present for the first time to the English speaking world the life and literary accomplishments of the little known but prolific Renaissance political writer, orator, and statesman, Polish born Christopher Varsevicius (1543-1603).

In achieving this objective the author presents an essay of monographic character---limited therefore to the subject---stressing its association with European political and cultural trends and contemporary sixteenth century political thought and practice. This historical background and context forms the setting necessary not only for the proper understanding of the literary and political life of Varsevicius but also and particularly for the correct interpretation and evaluation of the second and main part of the study, a translation of Varsevicius' De Legato et Legatione (1595).

The third part of the study, in the form of three appendices, lists the "Published Works" and "Manuscripts of Varsevicius' writings, including brief descriptions of his letters and essays, and a list of the "Representative Works of Sixteenth Century Ambassadorial Literature."

For the most part the study is based upon primary sources, that is, upon the works and letters of Varsevicius himself. The translation is from the original 1595 Latin text, which is included in the dissertation because the text required editing. Primary sources were used, whenever necessary, in the reconstruction, in chapters two and three, of the legal, political, and cultural framework within which sixteenth century ambassadorial literature took form.

The works of Varsevicius were studied from the first editions, which were made available by the British Museum collection; manuscripts were also obtained and studied from some ten European archives. Liberal use was also made of the Renaissance sources of American libraries.

The following are some of the important conclusions of this study.

1. The sixteenth century gave the world two distinct types of ambassadorial treatises: the predominantly juridical treatments of the ambassador which were concerned mainly with the rights of the legate and which appeared prior to 1585; and those which formulated a new theory of diplomacy that made the ambassador and his embassy an instrument of international peace. These distinctly different approaches to the subject correspond to the general political structure of states and the serious national and international problems which faced princes, kings, and ambassadors.

2. De Legato et Legatione was one of the first treatises which belongs to the new school of diplomacy. As such it is a notable contribution to the history of the development of diplomatic method, particularly because of its emphasis upon the positive role to be played by the ambassador and by negotiation on behalf of peace and harmony among nations. It is one of the first defined treatises on the art and theory of diplomacy, expressing a refined and cultured concept of the statesman-ambassador---the "accomplished ambassador."

3. De Legato et Legatione, although very practical in its advice and illustrations, is fundamentally a philosophical treatise after the fashion of the Greeks theorizing on the question of what makes a good man. Thus, underlying the practical and running throughout the book, is the Platonic theme of the wise and the virtuous. The book resembles the Ricordi of Guicciardini; the same meditative and introspective insights regarding human nature lay at the base of the political axioms of both works.

4. Finally, the influence of Varsevicius' Accomplished Ambassador upon the early development and evolution of classical diplomacy, which took definite form in the theory of Hugo Grotius in 1625 and in the practice of Cardinal Richelieu during the reign of Louis XIII, can be inferred from its wide circulation and numerous editions, especially that of 1646---upon the eve of the Treaty of Westphalia in 1648. His essay is a classic. As Grotius was one of the fathers of international law, so Varsevicius preceding him was one of the prominent founders of classical diplomacy. And, whereas there is no direct evidence that Suarez read Varsevicius, the idea, of De legibus ac Deo legislatore (1612), that states, though domestically independent, were

subject to a law of conduct by virtue of their membership in the human race is clearly expounded in De legato et legatione (1595).

Microfilm $5.50; Xerox $19.40. 432 pages.

INDIA AND BURMA, 1937-1957: A STUDY IN INTERNATIONAL RELATIONS.

(L. C. Card No. Mic 59-4640)

Richard J. Kozicki, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Norman D. Palmer

The purpose of this dissertation is to consider the particular and general international relations of India and Burma in the period 1937-1957. The emphasis is on Indo-Burma relations - political, economic and cultural. The method of historical narrative and topical analysis has been followed.

Largely as a result of their subordinate relationship to Britain, the common colonial power, India and Burma before 1947-48 offer a rather unique case in Asian international relations - two neighboring countries confronted and dealing with mutual problems and issues prior to independence. After Burma's piecemeal annexation to British India, Burma was administered as a British Indian province from 1886 until 1937. Various problems and issues developed between India and Burma, notably involving Indian immigration into Burma, trade relations, and the status and rights of the large Indian community residing in Burma. Burmese nationalism acquired an anti-Indian as well as an anti-British tone.

The separation of Burma from India on April 1, 1937, was accompanied by transitional safeguards designed to avoid a sudden disturbance in the Indo-Burma relationship. Indian special interests, particularly the commercial community in Burma and the Chettiar money-lenders, had substantial stakes in Burma and an abiding concern in the extension of these safeguards. Articulate Burmans were anxious to end them. Tensions connected with the anti-Indian riots in Burma in the late 1930's and the 1941 Indo-Burma immigration agreement were only removed in part by World War II and the Japanese occupation of Burma.

Organized Indian special interests, such as the Federation of Indian Chambers of Commerce and Industry, actively attempted before and after independence to influence the Government of India on their behalf in regard to Burma. Materials in their files show that their efforts to preserve the prewar status quo of Indians in postwar Burma were clearly interest or pressure group activity. The wartime exile and presence in India of both the Government of Burma and numerous Burma Indians encouraged this activity. The independent Government of India was apparently not prepared to begin disregarding these Indian special interests for a wider Indian national interest until early 1949.

Independent Burma's multiple insurrections, India's deteriorating food situation, India's northeastern frontier security, the emergence of Communist China, and the personal friendship between India's Premier Nehru and Burma's Premier Nu have all been factors in the development of friendly Indo-Burma relations from 1950, especially the latter. Indian special interests have lost by default. New Delhi's sympathetic understanding of Burma's problems is seen in Indian arms aid to Burma, recent Indo-Burma economic relations, and the gradual acceptance of Rangoon's immigration, land nationalization and related policies. Their common cultural heritage, their relatively complementary economies, the role of Burma's rice, and the similar international outlook of India and Burma as uncommitted nations in the Cold War have contributed to the growth of Indo-Burma friendship.

The treatment and future position of the Indian minority still in Burma may indicate whether the challenge of accommodation between India and Burma has been substantially met. The integration of the Indian community in Burma has not been as successful as that of India and Burma into the family of nations.

Foreign policy makers in the two countries, particularly India, have formulated a difficult third path in the bipolar postwar world, Asian "neutralism." This course has especially given India a greater influence in contemporary international relations than her power potential warrants. Burma's foreign policy is not, however, a carbon copy of India's. China remains their great challenge. The shared value patterns and interests of Indian and Burmese official elites should enhance the present friendly Indo-Burma relationship. Microfilm $6.55; Xerox $22.60. 513 pages.

ADMISSION TO MEMBERSHIP IN THE UNITED NATIONS AS AN INSTRUMENT OF DIPLOMACY.

(L. C. Card No. Mic 59-3525)

Nemesio Encarnacion Prudente, Ph.D.
University of Southern California, 1959

Chairman: Professor Berkes

Diplomacy is a means of achieving the objectives of foreign policy. The objectives and the circumstances are the determinants; diplomacy, in pursuit of the objectives and guided by the circumstances, uses various instruments and approaches. Diplomacy is not limited to the traditional concept of negotiation in good faith; it may be directed to harassing, embarrassing, or insulting the opponent. The purpose of this dissertation is to examine the use of the admission to membership in the United Nations as an instrument of diplomacy and by this, to assess its value in the attainment of the objectives of foreign policy. Emphasis is placed by this paper on the conceptual-analytical method. The manifold concepts or criteria used to serve the tactics and purposes of diplomacy are described and analyzed.

Admission to membership in the United Nations was regarded as a political rather than as a strictly juridical issue. Political considerations—such as increased voting strength, greater prestige, gaining political-economic concessions, preservation or expansion of political-economic ideology, recognition of the sphere of influence, strengthening of cultural, historical, racial, religious, or regional ties, or putting oneself in a better moral light than the opponent—were primary in guiding the attitudes and actions of United Nations members in their support or

rejection of applicant states. Political criteria were arbitrarily employed in the politics of admission to original membership. Regarding admission to subsequent membership, formal criteria were enumerated in Article 4, paragraph 1, of the Charter: that the applicant must be a peace-loving state, and able and willing, as judged by the Organization, to carry out the obligations of the Charter. Yet these criteria and their different elements were also arbitrarily applied. The applicant must possess the four elements of statehood: a territory, people, government, and sovereignty, the latter being determined by the mode of the establishment and maintenance of the state, the extent of the defense arrangements between the applicant and its former colonial power, its ability to conduct foreign relations, its disabilities resulting from the war, foreign occupation, unconcluded or unratified peace treaty, or the absence of de jure recognition or of diplomatic relations with particular members. The peace-loving nature of the applicant was questioned because of its alleged aggressive intentions or its use of aggressive means or unwillingness to employ pacific means in the settlement of disputes, its instigation of border incidents, interference with peaceful foreign shipping, unfavorable war conduct, or because of the existence of a technical state of war, or the absence of diplomatic relations between it and the United Nations member. Under ability and willingness to carry out the obligations of the Charter, references were made to the limited diplomatic contact of the applicant, its resort to military aggression, unfavorable war record, violation of peace treaty provisions, especially on human rights, its disregard of United Nations requests or decisions or its abrogation of existing treaties with United Nations members. These legal criteria were made to serve the political interests as the circumstances demanded or warranted. The Soviet view that "legal formula must be to express political ideas" was in practice accepted by the non-Communist members. Consequently, support of, or opposition to, candidates for admission followed political-ideological lines. Legal arguments were also used to denounce or defend the procedure of en bloc admission, the use of the veto by the permanent members of the Security Council which had prevented the favorable recommendation of qualified applicants, and the role of the Security Council itself. Similarly, the principle of universality was applied or twisted to serve the diplomatic purposes of each United Nations member.

Microfilm $5.85; Xerox $20.40. 459 pages.

THE EAST GERMAN LANDSMANNSCHAFTEN IN THE GERMAN FEDERAL REPUBLIC: THEIR ORGANIZATION AND INFLUENCE.

(L. C. Card No. Mic 59-4983)

Manfred Horst Schmidt, Ph.D.
University of Michigan, 1959

The purpose of this study is to describe the development and assess the influence of a number of unique organizations existing today in the West German community, the Landsmannschaften. The word Landsmannschaft defies direct translation and can at best be said to mean fraternal organization. In this case they are the associations of the millions of ethnic Germans expelled from Eastern Europe in 1945. This form of organization provided, therefore, the basis on which the Sudeten Germans, the Silesians, the East Prussians, and the other folk groups, after the loss of their homeland, were able to unite once more.

As this is the first attempt to treat the subject comprehensively it has been necessary to trace the historical background of the different groups. By showing their settlement in Eastern Europe, their expulsion, and their reemergence in a war-torn and divided Germany, it has been possible to underscore the diverse character of the folk-groups. In order to maintain and foster their distinct cultural characteristics they founded the Landsmannschaften. Considerable attention has been devoted to demonstrate their organizational arrangements, objectives, membership, and leadership, for these reveal the internal strength and problems of the organizations.

The second half of the study was designed to determine the degree of influence attained by the Landsmannschaften in the political affairs of West Germany. By examining the interest taken by the organizations in the nominations and elections of representatives to the Bundestag, it has been possible to establish the relations of the Landsmannschaften to the political parties. Access to the legislative process was measured by an examination of legislation in which the Landsmannschaften had a vital interest. Finally, attention has been directed to assess the influence developed in the work and personnel policies of the ministries of Expellee Affairs, Defense, and Foreign Affairs.

The general conclusion drawn from the study is that although the Landsmannschaften are supported and encouraged in their work of maintaining the cultural heritage of the folk-groups by the West German Government, their influence has been negligible in the affairs of the political parties, the federal legislature, and the federal ministries. Moreover, as economic and social integration in West Germany proceeds, the influence of the Landsmannschaften will in all likelihood recede. Only a radical departure by the Government from present policies could alter this situation. Microfilm $2.00; Xerox $6.80. 145 pages.

DIPLOMATIC RELATIONS BETWEEN CHINA AND THE UNITED STATES, 1844-1860.

(L. C. Card No. Mic 59-4097)

Te-kong Tong, Ph.D.
Columbia University, 1959

Sino-American diplomatic relations during the sixteen year period beginning with the signing of the Treaty of Wanghia and ending with Commissioner John E. Ward's resignation in 1860 laid the foundation for future relations between the two countries.

During this period the Chinese underwent an apprenticeship in modern diplomacy through two similar cycles. The first cycle began in 1839 with the rigid policy of Lin Tse-hsü and ended about 1850 with the failure of the appeasement policy of Ch'i-ying, who had signed the first treaty between China and the United States in 1844. The accession of the young Emperor Hsien-feng in 1850 marked the commencement of a second cycle of Chinese policy toward the West. Reverting to the intransigeance of his ancestors, the new Emperor made the stubborn, boastful, and

ignorant Yeh Ming-ch'en the guide of China's foreign policy for a decade. Though in popular eyes Yeh's long tenure was one of marked success, China's relations with the West were in fact steadily deteriorating during the 1850's. The disastrous consequences of the Arrow War in 1858 finally awakened the young Emperor to his danger, and belatedly he reverted to the appeasement policy that had been followed during the last years of his father's regime. Unfortunately this shift of policy came too late to produce any effective results; China was again involved in a foreign war which ended this second cycle and concluded the pre-modern era in the history of Sino-American diplomacy.

The United States during this era was slowly attempting to formulate a proper policy towards China. The initiative in this gradual development was taken by the successive American Commissioners to China. Prior to the inauguration of President Buchanan in March, 1857, the United States Commissioners to China were given a comparatively free hand in making their own China policies with little, if any, intervention from the Department of State.

Throughout the entire period, however, none of the American Commissioners in China waited for the arrival of his successor to transfer his official duties in person; and only one of these Commissioners, Peter Parker, lived in China as long as two years. The others had no personal knowledge of China, then a very mysterious land, before their appointment to that country. Hence because of ignorance and transience they could hardly formulate a workable China policy for the Federal Government. Thus none of their suggestions had any definite influence upon Washington and were usually set aside as soon as the original proposer left China. Nevertheless, their various proposals, with the exception of that of Peter Parker, were independently based upon one common principle, which in later years was known as the Open Door doctrine -- that is, the territorial integrity of China and equal commercial privileges for all Western Powers.

This common principle, which was intermittently proposed by different Commissioners, formed the general basis of United States policy towards China during the pre-modern period. President Pierce and Secretary of State Marcy made it the recognized national policy of the United States towards China just before they left office in the spring of 1857.

While the Open Door principle was in the process of formation during the pre-modern era, it encountered serious resistance from various interest groups and suffered constant setbacks before it could stand unshaken. American missionaries in China, and some American merchants as well, were inclined to reject the Open Door principle and to support British efforts in the Far East, Peter Parker who was given six interim appointments as American chargé d'affaires and in 1855 became Commissioner to China, actively espoused this policy of Anglo-American cooperation. Even after the recall of Parker in April, 1857, his policy was still supported by the China merchants, who were now in favor of close collaboration with the Anglo-French Alliance in China.

Neither merchants nor missionaries, however, were able to change the main trend of United States policy towards China. President Buchanan was as firm as his predecessor in guarding the Open Door principle. Thus the history of American diplomacy in China during this pre-modern era was the story of the gradual triumph of the Open Door principle. When Secretary of State John Hay in September, 1899, officially announced the Open Door policy, he was merely continuing the basic American policy towards China which his predecessors had quietly instituted over half a century earlier.

Microfilm $5.50; Xerox $19.40. 432 pages.

THE DEVELOPMENT OF I. L. O. PROCEDURES FOR MAKING AND IMPLEMENTING INTERNATIONAL LABOR CONVENTIONS BETWEEN 1945 AND 1957.

(L. C. Card No. Mic 59-2603)

Minta Chou Wang, Ph.D.
Columbia University, 1959

The International Labor Organization was the only League agency which survived the war ordeal practically unscathed. Emerging after the war as an autonomous international organization as well as one of the specialized agencies of the United Nations, the I.L.O. was able to utilize its past experience and improve on its procedures for making and implementing international labor conventions. This study has attempted to trace the development of such procedures between 1945 and 1957 and to analyze the significance of such development.

Chapter I of this study reviews both the origins, original structure and function, and accomplishments of the I.L.O. before 1945 and the pre-1945 procedures for making and implementing international labor conventions. Chapter II attempts to give an overall view of the I.L.O. in the context of its postwar constitutional amendments and its changed relationship from League of Nations to United Nations. The same chapter also attempts to point out the I.L.O.'s shift from a largely idealistic to a more realistic approach to international labor problems, thus leading to an increased emphasis on the practical application of international labor conventions.

Chapters III and IV respectively analyze the development of I.L.O. procedures in connection with the preparation and adoption of conventions. No important procedural change in either aspect has been found with the exception of the lengthening of the intervals for government consultation and Office preparation which proved to be an indispensable improvement.

Concerning the postwar procedures of implementing international labor conventions, Chapter V discusses the extended program of international supervision which requires members of the I.L.O. to report not only on ratified conventions but also on unratified conventions and recommendations. Chapter VI describes technical assistance as a means of primarily helping underdeveloped countries in the process of implementing or promoting the implementation of international labor conventions. The progress of international labor standards has therefore been measured in terms of degree of application of conventions and recommendations as well as number of ratifications of conventions.

As pointed out by Chapter VII, the establishment of the Fact-Finding and Conciliation Commission on Freedom of Association has added a new procedure to those used in connection with the settlement of disputes over the non-observance of international labor conventions. Although

this new machinery has not been resorted to, a great number of disputes have been closed or smoothed down by the Governing Body Committee on Freedom of Association through the use of the procedure of preliminary examination of complaints.

Regarding the postwar procedures for the revision of international labor conventions, Chapter VIII indicates little substantial change. In the practice of revision, more occasions have aimed at promoting ratification or application of conventions rather than elevating international labor standards. This again reflects the increased sense of realism of the postwar I.L.O.

In an overall evaluation of the postwar I.L.O. procedures for making and implementing international labor conventions, Chapter IX concludes that the greatest contribution which the I.L.O. has made is in its procedures for reporting on unratified conventions and recommendations. By combining the information received from both ratifying and non-ratifying states, the I.L.O. has been able to present a comprehensive picture of the position of states in relation to a certain convention or conventions. Through moral pressure derived from the supervisory system, the I.L.O. has slowly but steadily pushed its members toward better implementation of international labor standards. Further success of the I.L.O., however, would largely depend on the good will of governments and cooperation between and among all constituents of the I.L.O.

Microfilm $4.00; Xerox $13.40. 310 pages.

POLITICAL SCIENCE, PUBLIC ADMINISTRATION

GOVERNMENTAL FINANCIAL SUPPORT FOR HEALTH AND MEDICAL SERVICES IN THE UNITED STATES: A METHODOLOGICAL AND ANALYTICAL STUDY.

(L. C. Card No. Mic 59-4600)

Fred R. Brown, Ph.D.
University of Pennsylvania, 1959

Supervisor: Professor James C. Charlesworth

An important field of activity of governments at all levels in the United States is the regulation, promotion, and provision of health and medical services for their residents. Expenditures from social insurance and general revenue taxation funds, expenditures from fees paid for services, and subsidies for private expenditures through tax concessions are among the financial measures through which governments provide support for such services.

The purpose of this study has been to examine analytically the historical roots and the present status of governmental financial support for health and medical activities. Fiscal year 1956-57 has been selected as the key time period since that is the latest year for which the requisite data have been made available. Comparisons with earlier years have been made. The relationship of public expenditures and subsidies to other means of financing health and medical services has been explored: i.e., expenditures by consumers directly and through insurance, by business, and by philanthropy. Intergovernmental relationships as well as interjurisdictional and interfunctional comparative expenditures have been examined for their implications.

Specific financial data have been compiled from many sources; they are chiefly the 1957 Census of Governments and the agencies of the Federal Government which directly provide health and medical services or conduct grant-in-aid programs that include such services. The analysis extends to projected estimates of future expenditures that have been offered including those by various study committees and commissions.

Classification of activities and expenditures in public health and medical care for such an analysis should be broadly functional, cutting across organizational and program limitations. This requirement must, however, be tempered by the nature of the available data which tend to be programmatic. An examination of classification schemes employed in the United States and other countries as well as by the World Health Organization has been the basis of selecting a scheme that would be most suitable. This scheme emphasizes four major categories of public activity: medical care services, public health services, medical research, and medical facilities construction.

Expenditures from public funds for health and medical services reached a total of nearly $5 billion in 1956-57. Over 57 percent of these expenditures were derived from state and local tax sources. With the exception of medical research, state and local governments spent more than the Federal Government in every major category.

Public expenditures represented nearly one-quarter (24.1 percent) of combined public and private expenditures for medical and health services in 1956-57. On a per capita basis, private expenditures amounted to $92 and public expenditures were $29.

Public expenditures have increased from less than 15 percent of the total of public and private expenditures in 1928-29 to nearly 25 percent in 1956-57. However, the evidence appears to be that since 1949-50 public health and medical expenditures have declined slightly as a fraction of combined public and private expenditures, as a percentage of gross national product, as a percentage of total governmental expenditures, and as an amount per capita when corrected for changes in price levels.

While this study indicates that the level of governmental health and medical expenditures has stabilized, there are underlying influences that could promote further growth. Growth could come from expanded programs in medical research and in medical care of veterans, the aged, and the medically needy.

Microfilm $4.10; Xerox $13.80. 317 pages.

THE PRESIDENT MAKES A DECISION: A STUDY OF DIXON-YATES.

(L. C. Card No. Mic 59-4907)

Jason Leonard Finkle, Ph.D.
University of Michigan, 1959

The purpose of this study is to examine the mechanism by which a particular presidential decision was made and,

further, to assess the influence of presidential subordinates on the contents of the decision. This is a pioneer study of decision-making at the presidential level, involving several executive agencies. The particular decision examined was the Dixon-Yates decision which resulted from President Eisenhower's efforts to implement his electric power policy in the region of the Tennessee Valley Authority. The effectuation of the President's policy required the participation of the Bureau of the Budget, the Atomic Energy Commission, and the Tennessee Valley Authority. These organizations, along with the President, constituted the principal "decision-makers" who had official responsibility in the Dixon-Yates case. The decision-makers differed among themselves as to what should be done to advance the power policy enunciated by President Eisenhower. The Bureau, the AEC, and the TVA reacted differently to the President's policy and each of them sought to influence the decision which was eventually announced in the name of the President. The motivations, techniques, and degrees of influence of the decision-makers in affecting the substance of the decision are described and analyzed in this study.

The President was opposed to the TVA's plans to expand its steam generating facilities in order to satisfy its increased power demand. As an alternative, Mr. Eisenhower proposed that the TVA be relieved of part of its power commitment to the AEC's Paducah installation. In turn, the President wanted the AEC to purchase a like amount of power from a private producer. He assigned to the Budget Director responsibility for coordinating the Government's efforts to negotiate a contract. AEC Chairman Lewis Strauss offered his agency's cooperation in the matter. After six months of negotiations, the President decided to instruct the AEC to consummate a definitive contract with Dixon-Yates based on a proposal from that company.

In several fundamental respects, the Dixon-Yates proposal differed from the arrangement envisioned by the President in his original policy announcement. Instead of the AEC being the recipient of power produced by Dixon-Yates, the proposal anticipated delivery of power to the TVA. This change was suggested by the private utilities who argued that engineering and geographical considerations made it more efficient to deliver the power to the TVA at Memphis, to be credited to the AEC's account at Paducah. Neither the Budget Director nor the AEC Chairman resisted this change.

When the contents of the proposed contract became known, the Board of Directors of the TVA strongly objected to being made a recipient of private power through a contract between the AEC and Dixon-Yates. Similar opposition came from within the AEC. Three of Mr. Strauss' fellow Commissioners protested the AEC's role in the arrangement. Commissioners Smyth and Zuckert stated their opposition in a letter to the Budget Director, indicating their consent could only be obtained through a presidential directive. The Budget Director did not adequately inform President Eisenhower of the administrative hostility to the Dixon-Yates contract; moreover, he requested the President to make a decision in favor of Dixon-Yates without fully conveying the implications of his decision and informing him of the extent, basis, and sources of opposition within the executive branch.

Among the conclusions suggested by this study are the following: (1) There is an inevitable divergence of opinion within the executive branch on basic policy decisions involving the interests of more than a single agency. (2) This divergence is largely the result of the different role conceptions developed by various Government agencies. A presidential decision which conflicts with an organization's conception of its own role is subject to continued efforts from that organization to alter the decision or even resist its implementation. (3) As a consequence of the responsibilities of the office, as well as Mr. Eisenhower's own conception of the presidency, he was unable to command the decision-making machinery at the important junctures. Unless the President is accessible to those within the administrative hierarchy possessing divergent views, he will be dependent on the judgment of a few subordinates in selecting which decisions are to be made. Even these decisions will reach him in near-final form.

Microfilm $4.55; Xerox $15.20. 353 pages.

FIELD ADMINISTRATION OF THE BUREAU OF INDIAN AFFAIRS IN MINNESOTA AND WISCONSIN.

(L. C. Card No. Mic 59-3749)

John James Hebal, Ph.D.
University of Minnesota, 1959

Supervisor: Dr. Lloyd M. Short

This study concentrates on the Minneapolis Area Office, including its relationship with the Central Office above, and the agencies below, in the line of authority, and with other area offices, as well as relationships with other federal agencies and other levels of government. Field administration before and after the insertion of the area (regional) level in 1946 is compared. A summary administrative history of the Bureau is included. In addition to published materials, sources utilized include interview and selected files.

Introduction of the area level of supervision has markedly reduced contacts between superintendents and the Commissioner of Indian Affairs; contacts by superintendents and agency staffs with staff divisions in the Central Office have been somewhat reduced; relations with state governments have largely been taken over by the area office; relations with clientele have suffered somewhat because of the feeling of Indian leaders that the superintendent has lost much of his authority. Staff specialists assigned on a regional basis before the area level was created have been subordinated to the area director, but aside from frequent consultation with the area director and other branch chiefs, have experienced little change. The increase in technical staff supervision available to the agencies was for some functions substantial.

It was found that the regional system provides somewhat less adequately than the agency system for individual treatment of Indian groups of differing cultures; that anthropological research is neither systematically nor intensively utilized in field administration within the Minneapolis Area; and that transfers of field employees, especially superintendents, have been somewhat too frequent for maintenance of maximum effectiveness and high morale.

The general conclusion is that the area system is, from the national standpoint, a more effective organizational pattern in terms of central control, but that it has involved some losses in clientele morale. Because of extensive

delegations of authority, many matters can now be resolved at the area level which formerly required Central Office action. Thus time spent in Central Office - field communications probably has been somewhat reduced. The area director has made an important contribution to program coordination, and to relations with state governments. Improvement in administrative services resulting from their concentration on the area level was found, but removal of these services from the operating level has had some negative impact on the ability of the superintendent to exercise effective control. Advantages of increased specialization at the area level are in part compensatory.

Microfilm $6.50; Xerox $22.40. 509 pages.

MUNICIPAL GOVERNMENT IN THAILAND AS AN INSTITUTION AND PROCESS OF SELF-GOVERNMENT.

(L. C. Card No. Mic 59-4012)

Choop Karnjanaprakorn, Ph.D.
Indiana University, 1959

Municipal autonomy in Thailand is a product of the change of government from an absolute monarchy to a democratic regime since 1932. The devolution of municipal government to the local people is a part of the national policy of the decentralization of government and the establishment of a local self-government institution. It is also important because it is an attempt to provide a process of political democratization in order to familiarize the people in their localities with the methods and procedures of the parliamentary system, thus to make the national government more effective. The main purpose of this thesis is to ascertain what results this policy has produced in the past twenty-five years.

Chapter I is a general survey of the experience of the Thais in local government under the monarchy and the democratic regime. The dominant traditions of strong centralization are illustrated in Chapter II, and the psycho-socio-cultural factors influencing the attitude of the Thais toward their government institutions is discussed. There follows, in Chapter III, a thoroughly detailed description and analysis of the role of the Ministry of the Interior in connection with the execution of the national policy. Chapters IV, V, and VI describe the institution of municipal government through a discussion of its legislative and administrative organs, and the degree of autonomy permitted to it. Chapter VII deals with some problems connected with the execution of the policy and its acceptance by the local people.

The data, especially for the descriptive aspects of the study, were gathered from government documents, municipal reports, radio broadcasts, and by examining relevant documents, most of which are in Thai language. The knowledge and experience of the writer gained in over ten years of service in the Thai government are extremely important in the analytical interpretation made of the government.

The study shows that a democratic institution from the West transferred to a country which has different cultural values, beliefs, and government and administrative customs is affected greatly by the old traditions. When the government of the country is under the control of a ruling class, municipal institutions, in the process of development are influenced by that class according to their beliefs and values, and they are also affected by the social attitudes of the local people. Thus new forms of municipal government and administration have been greatly modified when finally established at the local level.

The traditional authoritarian habits and actions found in the relation between the central and municipal governments can also be found in the other branches of government. Autocratic rules, the avoidance of popular control, contempt for local freedom of action, and loyalty to persons rather than to institutions are very much in evidence. Democratic practices such as the initiative, referendum, and recall have not been used in the municipal government system in Thailand.

In summary, the study illustrates the effect of deeply ingrained autocratic traditions upon governmental structure, particularly in intergovernmental relationships and also upon relations between the government and the people.

Microfilm $3.65; Xerox $12.40. 282 pages.

BANGKOK GOVERNMENT AND ADMINISTRATION: APPEARANCE AND REALITY.

(L. C. Card No. Mic 59-4033)

John William Ryan, Ph.D.
Indiana University, 1959

This is an attempt to describe and analyze the formal and informal characteristics of urban local government in Thailand, using Bangkok as the focus. The intent is to establish the fundamental identity of the Bangkok municipal system by examining its historical, sociological, economic, political and religious setting.

In order to establish this identity it was necessary to examine both the cultural matrix underlying the socio-political behavior of the Thai, and the complex factors which contribute to the uniqueness of Bangkok in the Thai municipal system.

The unique position of Bangkok derives from its size, location, wealth, population and political importance, all having implications for its administrative form and identity. More important and fundamental to Bangkok's uniqueness, and contributory to its pre-eminence over other Thai municipalities is the pivotal political and religious role of the capital city in the spiritual experience of the Thai as borrowed from Brahmin cosmology, and the correlative historical tradition in Thai political development that all must be subordinated to the capital city, and the ruler of that city rules the Kingdom.

Bangkok government - both appearance and reality - is caught in the push and pull of contradictory forces in the current Thai socio-political environment. Historically, the Thai have been tolerant of alien values and imitative of alien institutions, yet highly resilient in preserving cultural identity. Thai success at survival diplomacy for three centuries attests to their adaptability, pragmatism and resiliency; this success itself making a cultural value of the adoption and imitation of forms and institutions from successful foreign cultures.

The significance of this cultural conflict for Bangkok is

brought out by examining some of the principal cultural values and forces presently competing in the socio-political system, including absolutism, centralism, westernization, decentralization, democratization, political power struggle and others.

Additional determinants of the politico-administrative pattern are discussed, such as the religious values observable in Thai motivation, precedent and tradition, the social organization, the mobility of the class structure, the importance of the governmental sphere in upward social movement, the religious values of orderliness, pragmatism and self improvement in this life, and other factors obviously critical in establishing the identity of the system.

The importation of foreign techniques coupled with the resilience of traditional Thai socio-political values results in adaptation of the foreign techniques in ways far different from their original form. The divergence of form and practice is particularly noticeable in matters of finance, purchasing, budget and personnel methods. In the personnel system of the municipality, for example, Western concepts of accountability, responsibility, merit promotion, efficiency, classification, and others are dutifully incorporated into the laws and regulations and given oral respect by the officials but are modified in practice by the influence of ancient cultural tradition wherein a subordinate tenders his personal allegiance to a superior in exchange for personal protection and favor.

Bangkok government and administration are burdened with problems of a general governmental nature as well as those more specifically administrative. The general governmental problems involve finding cultural and historical compatibility for democracy, representative government, technological change, local independence, responsibility and integrity.

In the administrative area, Bangkok also experiences its share of the same general problems which beset large cities throughout the world. These problems arise from common causes: population increase, health needs, inadequacies of sanitation, education, transportation, and communication. Specifically, Bangkok faces problems arising from the influx of poorly educated, unskilled peasants seeking temporary cash income, alien groups which dominate industry, commerce and trade, lack of community consciousness, and others. Within the administrative structure itself, Bangkok is hampered by inadequacies of personnel, finance and method.

Solutions to Bangkok's major problems will come only as there are changes in the broad social system. Deep and fundamental changes are underway already as a result of the clash of tradition and custom with the realities of modern economic and political competition. It is not possible to predict the velocity or the direction of the changes, but already there are clear indications of the nature of the emerging class system, the bases for social status, and the problems of governmental and non-governmental organization. Microfilm $4.35; Xerox $14.60. 337 pages.

A STUDY OF THE COMPETENCE OF THE BARRIO PEOPLE TO CONDUCT BARRIO GOVERNMENT.

(L. C. Card No. Mic 59-4403)

Buenaventura M. Villanueva, D.P.A.
University of Southern California, 1959

Chairman: Professor Sherwood

Grants of autonomous government powers to the barrios will have to be conditioned by the barrio citizens' possession of competencies for self-government. However, very little is known about this matter. This study seeks to discover and to measure the competence of barrio people to conduct barrio government.

Hypotheses. (1) Barrio government requires the possession of certain competencies on the part of the rural people, and these competencies may be derived partly from experience that can reasonably compare with that acquired in government work, and partly from the possession of economic and technological resources indispensable in maintaining barrio government. (2) Barrio government requires a willingness on the part of the barrio people to assume the responsibilities incident to such government. (3) Barrio government provides a basis for meeting the value requirements of a democratic society.

Methodology. Data for the study were sought through (1) personal interviews with 236 respondents distributed equally among 59 barrios throughout the country, (2) analysis of real estate records for the 59 barrios, (3) personal interviews with a cross section of the members of Congress, and (4) analysis of available literature from recent studies on the socioeconomic life of rural people.

Interviews with the barrio respondents centered on barrio experiences in, and attitudes generated by, certain indigenous institutions as the fiesta, parent-teacher associations, informal cooperative activities on the farm, the family and related activities like marriages and internal decision making, and other neighborhood groupings. Interviews with congressmen were focused on their attitudes toward barrio government and the probable reasons therefor.

Findings. (1) In celebrating fiestas and other community celebrations, in managing parent-teacher association projects, in building local roads and schoolhouses, and in observing the demands of other indigenous institutions, the barrio people seem to have acquired certain skills and proficiences that could well be utilized in barrio government. These skills and proficiencies include the ability to (a) direct and/or work with groups, (b) plan and execute plans, (c) initiate relatively untried activities, (d) manage money matters, (e) exercise "democratic" methods in group work, (f) assess community needs, and (g) evaluate the community's capacity to meet these needs. (2) There are abundant indications that the people in the barrio know what their problems are and are willing to participate in their solution whenever they feel they are competent to do so. (3) The existing property tax may be exploited to support barrio government. Moreover, as shown by experiences in fiesta financing, other barrio fiscal resources exist, though largely undefined and inadequately identified.

Conclusions. (1) If skills and proficiencies alone are considered, the barrio people can claim a high degree of competence for barrio self-government, especially as

these skills and proficiencies are supported by favorable attitudes and financial resources. (2) All these, however, must be seen as being conditioned by the Philippine cultural matrix which is characterized by authoritarianism, close family ties, and contradictory socioeconomic values. (3) Thus, the expansion of governmental powers at the barrio level is not simply a matter of skill or proficiency. Legislators and administrators particularly have a markedly different perception of these barrio competencies, and there are many cultural and political reasons why these attitudes will persist. (4) In the last analysis, the determination of the barrios' competence to govern themselves must be weighed in terms of (a) the findings of this study that the barrios do have the necessary technical competence and resources to undertake such activity, (b) the unique cultural matrix of Philippine life, and (c) a value system held by administrators and legislators, rooted partially in emotion and partially in political reality, that rejects the expansion of such powers.

Microfilm $5.10; Xerox $17.00. 397 pages.

PSYCHOLOGY

PSYCHOLOGY, GENERAL

MEDIATED GENERALIZATION AS A FUNCTION OF SEMANTIC DIFFERENTIAL PERFORMANCE.

(L. C. Card No. Mic 59-4709)

James Cleveland Baxter, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Ira Iscoe

The present investigation was designed as a test of two implications of the theoretical position of Osgood and his associates. These investigators have proposed certain relationships between semantic space characteristics and corresponding representational mediation processes, such that point locations in semantic space may be regarded as operational reductions of the meaning of any given experimental signs. In addition, they have proposed that similarity of meaning between signs may be indexed by a composit measure of multidimensional similarity, D.

Two hypotheses were proposed as tests of this postulated correspondence. Hypothesis one predicted that the amplitude of a generalizing response among a sample of diverse experimental signs should bear a reliable inverse relationship to the multidimensional distance, D, between any given sign and the sign to which the response was initially trained. Hypothesis two proposed that trends of the amplitude of a generalizing response should differ between two experimental groups as a function of differences in location on the evaluative dimension of the semantic differential of the sign chosen as critical for response training.

A mediated stimulus generalization design was employed in testing these predictions. A sample of six experimental signs were chosen, so as to represent the range of the evaluative dimension of the semantic differential. One of these signs (words) was chosen as critical for each individual subject, and the galvanic skin response was trained. Generalization of this response to non-critical words was measured, and these generalization data were utilized in testing the hypotheses.

Hypothesis one of the present study failed to receive confirmation in the data. No systematic variation was found in the generalization data which could be attributed to multidimensional D. Hypothesis two of the present study was confirmed at the .05 point of confidence. Differences in generalization trends occurred in the predicted direction.

Two auxiliary analyses were conducted on hypothesis one data. These measures also failed to reveal the predicted relationship. A replication study of hypothesis one was also conducted to determine the reliability of the initial result. Results of the replication experiment also failed to support hypothesis one.

The results of hypothesis one were interpreted as failing to confirm the postulated relationship between multidimensional D and meaning similarity. The support of hypothesis two in the present investigation was interpreted as confirming the postulated relationship between the evaluative dimension and corresponding representational mediation processes. The composit results were regarded as providing limited support for the position proposed by Osgood et al.

Microfilm $2.00; Xerox $4.40. 81 pages.

SOCIAL VALUE-NEED PATTERNS IN MENTAL RETARDATES.

(L. C. Card No. Mic 59-5096)

Thomas Edward Bolduc, Ph.D.
The Pennsylvania State University, 1959

The purpose of this investigation was to isolate and identify common patterns of solutions to social value-need conflict situations in mental retardates. When an individual is confronted with a situation involving a conflict between a social value and a social need, which course of action will he take? Will he respond in terms of gratifying a social need or will he conform to the social value? It is by their response to problem situations that most people come in conflict with society.

To determine the nature of common patterns of conflict solutions, a scale consisting of 95 items, devised to measure social value-social need conflicts, was administered to 50 white, female retardates between the ages of 14 and 18 with an IQ range of 55 to 80. Half of these subjects were drawn from an institutionalized population in a state training school for female retardates. The other 25 were drawn from a population of retardates of similar age, intelligence,

race and socio-economic status attending special education classes in 12 public schools.

Each item was constructed so that the subject was required to make a forced-choice response, on the basis of what was believed to be the best choice, to a familiar, social conflict situation. One choice of response depicted a social value and the opposite choice depicted a social need. The social value dimension was arbitrarily divided into honesty, loyalty, moral courage, and responsibility. The social need dimension consisted of nurturance, succorance, dominance, affiliation, and deference. Each value was paired with each need, resulting in 20 possible combinations of situations. There was a mean of five replications in each combination.

The intercorrelations of the subjects on their responses to the items were factor analyzed and orthogonal rotations revealed six definable factors. To give definition to the factors, each item of the scale was correlated with the factor loadings for each person. The items which were highly correlated with factors were interpreted in terms of their structure.

Factor I stressed a passive, compliant approach to authority figures, with responsibility being the most dominant value. Factor II emphasized loyalty and the protection of others, with loyalty being the most dominant value. Factor III was tentatively defined as submission in situations involving authority figures but with more assertive behavior in relationships with peer groups. Factor IV stressed honesty and moral courage, suggesting an assertive, dominant individual who prefers to participate in the correction of others' misbehavior. Factor V stressed the need to be dominant in relationships with peer groups. Although values are recognized, they are frequently distorted and employed as weapons with which to gain dominance. Factor VI stressed a negative, rebellious approach to social situations involving authority figures, with an underlying need for affection and pleasurable activities dominating their behavior.

The feasibility of employing this or a similar instrument to differentiate institutional and non-institutional retardates was explored. Practical applications of the results were discussed, such as the possibility of devising a screening instrument, weighted with the items that best discriminate the two samples, to aid in the selection of parole candidates.

The major hypothesis of this study was confirmed. Psychologically meaningful dimensions were revealed when the matrix of intercorrelations of subjects' responses to the research instrument was factor analyzed and the arbitrary orthogonal axes rotated.

Some evidence was obtained that with refinement and additional analysis, certain items as represented by Factors I, V, and VI might be useful in differentiating institutional from non-institutional retardates.

Microfilm $2.00; Xerox $5.00. 97 pages.

PATTERNS OF HOSTILITY AMONG THE RETARDED

(L. C. Card No. Mic 59-5101)

Ellen Culbertson, Ph.D.
The Pennsylvania State University, 1959

The study was designed to investigate the patterns of hostility, which may be differentiated by means of an inverse factor analysis, which serve different functions for the individuals utilizing the patterns. The three functions of hostility under investigation were hostility as a response to frustration, hostility as a defense against anxiety-producing drives, and hostility as an anxiety-producing drive against which defenses are developed.

Items were constructed which exemplified the three functions of hostility under investigation. Each item contained one level of three variables, a situation variable, a drive variable, and a response variable. All possible combinations of the levels of the variables provided twelve item categories, some of which exemplified hostility as a response, a defense, or a drive to be defended against. Each item included the brief statement of a situation, followed by a question stating a drive and response. Subjects responded to the questions by stating whether they agreed or disagreed that an individual involved in the situation mentioned would feel and act in the way described. A pilot study indicated that the subjects were able to respond to the items reliably and that there were sufficient variability of response to the items to discriminate between subjects.

The subjects were randomly selected from a population of institutionalized mentally deficient women who ranged in age from 18 to 22, had an I.Q. range of 50 to 80, and had never been diagnosed as brain damaged or psychotic.

The items were administered to the subjects, and the responses of each subject were correlated with the responses of every other subject in the sample. This correlation matrix was factor analyzed. The interpretation of the rotated factors was based upon analysis of the items most highly correlated with each factor.

Six factors were obtained. Three of the patterns are primarily associated with hostility as a drive against which defenses are developed. The factors are distinguishable on the basis of awareness of hostile impulses and preferred type of response. Subjects described by Factor I use intropunitiveness or impunitiveness as a defense against impulses to act out and fairly frequently deny hostile impulses. They occasionally use intropunitiveness as a response to frustration. Factor IV involves complete denial of hostile impulses and the absence of any type of aggressive response. Factor V describes subjects who are aware of their hostile impulses but control them by utilizing only impunitive responses. Factor II is distinguished by some tendency to act out aggressively in response to frustration. This group rejects the utilization of defenses against hostile impulses. Factor III is descriptive of individuals who are concerned with the use of hostility as a defense. This factor is bipolar and includes individuals who both use and deny the use of hostile defenses. Factor VI describes individuals who make use of all three functions of hostility, with choice of function apparently determined primarily by the specific situation to which they are responding.

The results of the study confirm the hypothesis that

different patterns of hostility may be differentiated and shown to have somewhat different functions for the individuals utilizing the patterns.

Microfilm $2.00; Xerox $5.00. 97 pages.

THE DEVELOPMENT OF A BATTERY OF SYNTHETIC DEXTERITY TESTS BASED ON ELEMENTAL MOTION PATTERNS.

(L. C. Card No. Mic 59-4137)

Donald William Drewes, Ph.D.
Purdue University, 1959

Major Professor: E. J. McCormick

A research problem in industrial psychology dealing with the development and validation of an experimental battery of dexterity tests which simulate patterns of elemental job motions.

The purpose of this research was the development of an experimental series of dexterity tests which incorporated many of the elemental motion patterns used in job performance. By applying the principles of motion analysis to the development of dexterity testing, it was thought to be possible to simulate the motion sequences of a large number of jobs, particularly those jobs of a bench-assembly nature. It was felt a test capable of simulating job motion patterns would more adequately duplicate the actual job and would therefore better predict job success than would conventional dexterity tests involving motion patterns not specifically chosen for the individual jobs. If tests which simulate patterns of job motions could be found generally to have substantial validity, it might then be possible to identify appropriate tests by a comparison of their patterns of motion with those of jobs, and use them without conventional validation procedures.

The experimental model, called the Purdue Elemental Motions Tests (PEMT), consisted of fourteen boards of the pegboard type, and eighteen sets of corresponding pins. These tests were designed so as to collectively parallel many of the basic motion elements of the Methods-Time Measurement (MTM) system of predetermined times. The testing tasks of the PEMT were unique in that they made provision for factors such as tolerance of objects requiring assembly, the shape and size of objects handled, the distance reached, and the type of grasp required to handle the object. Given this information about each job, it would be possible to select the appropriate variations of the PEMT which appeared to offer the best chance of simulating the patterns of job motions.

It was therefore hypothesized that the predictive validity of the PEMT would be generally higher than the predictive validity of conventional dexterity tests involving motion elements which were not tailor-made for the individual jobs. It was further hypothesized that a sub-test of the PEMT which was thought to most closely match the pattern of motion elements of a job would correlate higher with a criterion measurement than would a sub-test thought to be least representative of the pattern of actual motion elements.

In order to test these hypotheses, three variations of the PEMT and a conventional dexterity test were administered to an industrial sample consisting of eight workers from each of nine repetitive bench jobs. The criterion for each job was a production index. The validities of the PEMT variations, when generalized over the nine jobs, were significantly higher than the validity of the conventional dexterity test. Those variations of the PEMT thought to be least representative of the job were found to have a significantly lower correlation with the criterion over all jobs than did the most representative PEMT.

On the basis of the research results, the following conclusions seem warranted:

1. The predictive validity of a dexterity test designed to simulate a large number of motion patterns characterizing assembly-type jobs will generally result in higher predictive validities than will a conventional dexterity test involving rather different patterns of motion.
2. The selection of appropriate predictive tests on the basis of job motion patterns offers the test practioner a formal procedure for the selection of dexterity tests.
3. The validities of certain tests may be generalized to similar job situations without the benefits of conventional validation procedures.

Microfilm $2.00; Xerox $4.80. 94 pages.

REACTIONS OF INTELLECTUALLY NORMAL AND RETARDED BOYS AFTER EXPERIMENTALLY INDUCED FAILURE---A SOCIAL LEARNING THEORY INTERPRETATION.

(L. C. Card No. Mic 59-1100)

William Irvin Gardner, Ph.D.
George Peabody College for Teachers, 1958

Major Professor: Rue L. Cromwell

The present study represents an attempt to compare the responsiveness of groups of intellectually normal and retarded elementary school-age boys to patterns of experimentally imposed failure experiences. In the derivation of the hypotheses of the study, certain constructs of the social learning theory by Rotter were used.

Sixty mentally retarded boys were matched into pairs with 60 normal boys on the basis of a simple motor-discrimination task highly similar to the task used to obtain the experimental response measure. These matched pairs were assigned to comparable experimental or control groups.

Initially, each subject of the six groups utilized was given a two-minute trial on a simple card-sorting task. The number of cards sorted in the two-minute period defined the response measure of this task. Following this, Ss of the four experimental groups were given four trials on a block-marking task. On this task the Ss were attempting to win a prize that had previously been selected. One set of retarded and normal groups (total failure) received failure on all four trials. Another set of retarded and normal groups (partial failure) experienced three initial subgoal successes, followed by a final failure which

resulted in the loss of the prize. Immediately following the experiences of this intervening task, all Ss were again given a two-minute trial on the card-sorting task. It was assumed that the effects of the intervening failure would be reflected in the difference in the number of cards sorted in the initial and final card-sorting tasks. Control groups, who received no apparent success or failure on the intervening task, were utilized to control for such factors as practice or learning effects, fatigue, passage of time, boredom, etc.

An assumption was made that mentally retarded Ss would enter into a relatively novel task with a low generalized expectancy of success. This assumption was based on observations that the retardate has had a preponderance of failure experiences in a wide variety of prior life situations. Since, from a SLT viewpoint, the magnitude of failure effects is defined in terms of the amount of discrepancy existing between level of expectancy and actual situation outcome (the greater the discrepancy, the greater the effect), it follows that the retardate's subsequent behavior would be less influenced by failure than would be true of the normal. Predictions based on this reasoning were upheld. Following failure the normals did show greater absolute changes in subsequent behavior than did the retardates.

It was further predicted that the partial failure groups would show a greater absolute effect of failure than would the total failure groups as a consequence of the greater expectancy-outcome discrepancy which theoretically existed at the time of failure. This prediction was not upheld in either the normal or retarded group comparisons. However, each of the two failure conditions led to a greater absolute change in subsequent behavior than did the non-failure control conditions for both retarded and normal.

Proceeding from the notion that failure has situational cue properties which might lead to a recategorization of a task situation from one of success striving to one of failure avoidance, it was predicted that retardates would more typically show a withdrawal or decremental type of responsiveness following failure, whereas the normal would more characteristically show an increment in performance. This prediction was upheld.

It was concluded that the retardate's performance efficiency in a wide variety of experiences probably suffers as a consequence of the reduced level of expectancy of success. Furthermore, failure as a motivating variable is probably less effective with the retardate than with the normal.

Microfilm $2.00; Xerox $5.80. 118 pages.

THE DEVELOPMENT OF A RECONSTRUCTION-FORM TACTUAL TEST FOR USE WITH THE ADULT BLIND.

(L. C. Card No. Mic 59-4145)

Alin Gruber, Ph.D.
Purdue University, 1959

Major Professor: Dr. Joseph Tiffin

The purpose of the research was to develop a special ability test which would yield a combined measure of both tactual perceptiveness and gross manipulative dexterity. The test was to be applicable for use with the legally blind, including both those persons who are totally blind and those who still possess partial vision in the better eye or in both eyes. It was desired that the test be of assistance in vocational selection, placement and counseling, especially with regard to the many occupations which require the blind to use their hands in earning a livelihood.

A special ability test for use with the adult blind was constructed using a pegboard format. The test was designed to yield a combined measure ot tactual perceptiveness and gross manipulative dexterity. Examinees were required to reconstruct six items, which were composed of patterns or configurations of pegs, as accurately and quickly as possible. The test was administered to 318 legally blind subjects who were between the ages of 20 - 50 and who had no other major handicap in addition to blindness. In taking the test, subjects were allowed to use whatever residual vision they possessed. Performance on the test was scored on the basis of logical considerations, and this resulted in a total index score combining accuracy of reconstruction, correctness of location, and time required for reconstruction, for each item.

A distribution of total index scores for the entire sample showed that scores on the test tend to be distributed in an approximately normal manner. The relative difficulty of the items was estimated from the mean and standard deviation for each item as determined from the entire sample, and this evidenced that the test items had been presented to subjects in a general order of increasing difficulty.

The estimate of the internal consistency reliability of the test scores for the entire sample yielded an obtained coefficient of r = .93, using Hoyt's analysis of variance method for computing reliability. The obtained estimates of the validity of the test scores were r = .58 and r = .47 between the outside employed (N = 84) and the unemployed (N = 34) criterion groups and between the outside employed and the shop employed (N = 105) criterion groups, respectively. Scores on the test did not differentiate between the shop employed and the unemployed criterion groups. The estimate of the validity of the test scores with ratings on a sample of shop employed blind from Chicago (N = 32) was r = .54. For another sample of shop employed blind from St. Louis (N = 52), the obtained estimate of the validity of the test scores with ratings was r = .46.

The relationship between remaining vision and scores on the test yielded an obtained estimate of r = .39, based on the data from 314 subjects. The magnitude of the relationship between vision with scores on the test was not considered excessive in view of the obtained estimates of the reliability and validity of the test scores for the sample and various sub-groups. Data are presented that indicate that remaining vision was related to and/or contributed to the systematic variance of some of the criteria of vocational success that were used. An observation is also discussed which suggests that several of the test items possibly reveal the presence of a perceptual disorder and/or brain damage, i.e., several subjects could reconstruct certain items only in a mirror-image or inverted form.

A principal components factor analysis was performed to investigate the theoretical structure of the reconstruction test. Included in the intercorrelation matrix were two part scores representing pure manipulative dexterity and

two subtests of the WAIS verbal section. The factor analysis resulted in a single factor accounting for the systematic variance among the items of the reconstruction test. This single factor was a common factor which was composed of both tactual manipulative dexterity and tactual and/or general perceptiveness.

The following conclusions were made regarding scores on the reconstruction test for the sample of the blind population tested: (1) the test scores are reliable and have demonstrated validity to a useful extent; (2) the test scores do yield a combined measure of both gross manipulative dexterity and tactual perceptiveness. It is felt that the tactual reconstruction pegboard should prove of assistance in the vocational selection, placement and counseling of the adult blind. Microfilm $2.00; Xerox $5.80. 116 pages.

A DEVELOPMENTAL STUDY OF PERFORMANCE ON THE HUNTER-PASCAL CONCEPT FORMATION TEST.

(L. C. Card No. Mic 59-4258)

Ernest R. Larsen, Ph.D.
The University of Tennessee, 1959

Major Professor: Gerald R. Pascal

The present study investigated the ontogenetic relationship between the ability to perform on the Hunter-Pascal Concept Formation Test (H-P Test) and chronological age (CA) and Mental Age (MA). The H-P Test uses an apparatus consisting of a white, wooden wall with five black doors; the doors are exactly alike. The subject's task was to discover which door concealed a reward consisting of "corn candy." The pattern of the placement of the reward behind the doors varied through eight problems arranged in order of increasing difficulty. The beginning tasks are modifications of the delayed reaction and double alternation problems of Walter S. Hunter, and the more difficult problems are a serial combination of single and double alternation. The H-P Test was easy to administer, and it had high stimulus appeal for the subjects. It required little time, seldom more than a half-hour.

A sample, stratified with regard to CA, of ten "normal" children, five males and five females, was drawn from each of the even numbered school grades, second through twelfth. This resulted in a total of sixty subjects.

The H-P Test yielded two main dimensions of performance: the Presentation Score and the Error Index. The differences between the scores obtained by the various grade groups on both measures was significant beyond the .01 level. These two measures were related to CA and MA and orderly graphic functions were obtained. Although the small sample size required caution in interpretation, the MA curve was slightly positively accelerated and the CA curve was slightly negatively accelerated.

The relationship between these two test dimensions and CA and MA was also investigated with correlational statistics. Presentation Score correlated +.76 with MA and +.58 with CA. A partial correlation was computed holding both variables constant, and when MA was partialed out the correlation of Presentation Score with CA dropped to -.01. This pointed out that the MA variable, with a remaining r of +.60, possessed the primary relationship. When correlation coefficients were computed for Presentation Score versus MA and CA within all six school grade groups, an interesting relationship was discovered. The CA and MA variables had a complementary relationship. For the younger subjects, CA was most highly related to success at the H-P Test, but, once a certain age was reached (about the sixth grade), the primary relationship was with MA.

The Error Index correlated +.54 with CA and +.44 with MA. When the effect of CA was partialed out the relationship between Error Index and MA dropped to +.02, leaving a remaining r of +.38 for CA. Thus the ability to learn the problems appeared most dependent upon MA while being able to avoid errors was related most highly to CA.

Both test dimensions were also investigated regarding their relationship to academic achievement as revealed in school grade point averages. The Presentation Score correlated +.34 with contemporary grades and +.10 with past grades: the Error Index correlated +.06 with contemporary grades and +.24 with cumulative grades. The Presentation Score had a moderate relationship with Stanford Achievement Test Scores (+.42, +.50, and +.65) in the portion of the experimental population (one-third) for which this information was available.

Both H-P Test measures were lesser predictors of contemporary grades than IQ scores or past grades which correlated +.69 and +.88 respectively. Since both the IQ scores and past grades were known to the grading teachers, there is some question of the contamination of judgments because of the lack of independence.

Contrary to many developmental investigations which demonstrate earlier maturation by girls, they did not demonstrate any superiority of performance over that of the boys.

A direction for further research has been suggested in the area of the relationship between the H-P Test performance and psychological adjustment.

As a result of this and similar studies it has been demonstrated that a series of problems such as those of the H-P Test yield orderly data which imply increased cortical efficiency as we ascend the phylogenetic scale, and this efficiency is on a continuum from the lower vertebrates to adult human organisms.

Microfilm $2.00; Xerox $5.80. 120 pages.

A JOB CLUSTER ANALYSIS IN TERMS OF APTITUDE ACTIVITY ELEMENTS.

(L. C. Card No. Mic 59-4166)

Richard R. McCracken, Ph.D.
Purdue University, 1959

Major Professor: C. H. Lawshe

The purpose of this study was (a) to perform a job cluster analysis on 52 jobs, (b) to modify Tryon's use of the B-coefficient cluster analysis technique and (c) to develop a statistic to obtain a job intercorrelation matrix.

Using the completed Check Lists of Hourly and Non-Exempt Job Activities for 52 hourly and non-exempt jobs

in two different plants, the intercorrelation matrix for these jobs was obtained.

A modification of Tryon's use of the B-coefficient cluster analysis was developed and used to identify 9 clusters of hourly and non-exempt jobs. The jobs within each cluster were similar in terms of common activity elements.

The clusters, or groups, of jobs identified were: (a) Machining, (b) Processing, (c) Assembling, (d) Forming, (e) Planning, (f) Routine Finishing, (g) Routine Cleaning, (h) Stock Handling, and (i) Laboring.

A procedural outline for a B-coefficient cluster analysis was written. Microfilm $2.00; Xerox $4.20. 80 pages.

A FACTORIAL STUDY OF THE JOB PREFERENCES OF INDUSTRIAL MANAGERS.

(L. C. Card No. Mic 59-4173)

Paul John Patinka, Ph.D.
Purdue University, 1959

Major Professor: C. H. Lawshe

This study involves an attempt to identify the basic dimensions in a set of job related variables, to determine and analyze scores for these dimensions, and to relate the results to the problem of managerial motivation.

In response to an open-end questionnaire, 87 managers in a manufacturing plant compared their own jobs with those of their subordinates and immediate supervisors. Specifically, each was asked to state the ways he felt his own job was superior to the jobs of his subordinates and immediate supervisor, and the ways he felt their jobs were superior to his own.

Theme analysis of the 1033 obtained statements yielded 25 job themes. The intercorrelation matrix for these themes was cluster analyzed and four clusters of job themes were identified.

From the results of the theme and cluster analyses, 18 job characteristics were developed and arranged for paired-comparison evaluation.

The responses of 310 managers to the paired-comparison of job characteristics were separated into three groups based upon the job level of the respondents. Intercorrelations of the job characteristics were computed separately for each of the job level groups, foremen, general foremen, and superintendents and higher.

Each intercorrelation matrix was factor analyzed, and eight bipolar factors were identified for each job level group. The factors for the foreman group, used as the basis for comparison of the factors for the other two groups, were named as follows:

I - Higher Management Orientation vs. Job Placidity
II - Personal Contact vs. Isolation
III - Personal Independence vs. Dependence
IV - Job Expansion vs. Fixed Job Expectancies
V - Desire for Advancement vs. Present Position Improvement
VI - Ego Satisfaction vs. Monetary Reward
VII - Personal Impact vs. Work Regularity
VIII - Job Security vs. Personal Insecurity

Comparison of the factor poles obtained from the three matrices revealed a considerable degree of similarity. The complete factors, however, differed from group to group largely in terms of the sub-dimensions represented by the opposing poles.

Factor scores were determined by means of the multiple regression approach. Because of differences in the factor structure of the three groups, the regression equations were derived from foreman responses and applied across all job levels.

Classifications used in the analyses of factor scores were made on the basis of job level, job type, AGCT score, age, and consistence of paired-comparison responses.

The results of the analyses of factor scores disclosed meaningful differences in stated preference. Related to the motivational theory of Maslow, they seem to corroborate his postulation of the existence of a hierarchy of relative prepotency within the realm of basic human needs. When confronted with a choice situation, the tendency was for those men least satisfied in terms of lower order job needs to indicate a greater desire for satisfaction of such needs. As regards the higher order job jeeds, it is apparent that those already most satisfied tended to express the desire for still greater satisfaction. Thus, while the lower order job needs appear to have a point of satiation, the desire for satisfaction of higher order needs seems almost unlimited. Preference for an increase in those activities related to basic managerial functions apparently derives, in part, from the attainability of such increases as perceived by the individual.

While available measurement and statistical techniques appear to offer useful approaches to the investigation of job needs, the results obtained here remain largely descriptive. A suggestion for further research involves a follow-up study designed to ascertain more adequately the cause-and-effect relationships between job preferences and such variables as job level.

Microfilm $2.00; Xerox $7.00. 146 pages.

A STUDY OF VERBAL CONDITIONING AND ITS RELATION TO DEPENDENCY.

(L. C. Card No. Mic 59-5016)

Leonard I. Rosenberg, Ph.D.
University of Kansas, 1957

The main purpose of this investigation was to study the relationship between dependency and susceptibility to verbal conditioning, using approval as reinforcement. A second major aim was to conduct a limited investigation of the generality of such susceptibility.

Dependency was measured in terms of S's self-description using an array of items developed by Fordyce and Lamphere. Slight modifications of 2 verbal conditioning situations were studied, one used by Taffel and another by Kanfer. S's were 71 students in an introductory psychology course. In the Kanfer situation they were exposed to a small light under conditions which usually produce autokinetic movement, and were asked to give numerical estimates of the distance the stimulus light moved during each trial. A pre-reinforcement sample of 30 estimates was

obtained. A range of estimates was then selected by E in such a manner that estimates within this range had a probability of occurrence of .2. E then began to reinforce such estimates with comments implying that the estimate was accurate, using a 67 per cent schedule of reinforcement. This procedure was continued until S gave 6 estimates within the critical range during a sequence of 10 responses. The number of trials to reach the criterion was the measure of susceptibility to reinforcement.

In the Taffel situation, S's were presented with a series of cards, on each of which was a verb and the 6 personal pronouns, We, I, He, She, They, You. They were asked to respond with the first sentence that came to mind, using the verb and beginning their sentences with any of the pronouns. Taffel reinforced sentences beginning with We or I by commenting "Good" in an impersonal manner. He obtained an increase in the frequency with which S's began their sentences with the critical response class, We or I. In the present study the response class selected for reinforcement was not limited to We and I. Fifty new cards were presented to S a few days later and sentences beginning with the selected pronouns were reinforced by E's commenting "Good." The change in frequency of occurrence of the selected pronouns was taken as the measure of conditioning. Following this, an inquiry was conducted to screen out S's who were aware of the contingency between use of particular pronouns and E's reinforcement.

The hypotheses investigated, and the relevant findings were as follows:

1. No support was found for the hypothesized relationship between dependency and performance in either the Kanfer or Taffel situations.
2. A slight, but discontinuous, tendency was found for positive effects in one situation to be associated with positive effects in the other.
3. S's who showed positive effects in both situations were not found to have significantly different dependent scores from S's who failed to show positive effects in either situation.
4. Verbal conditioning was effective with other pronouns as well as We and I in the Taffel situation.
5. Contrary to expectations, initial preference for competing pronouns was found to be positively related to conditioning in the Taffel situation.
6. No support was found for the hypothesis of an inverse relationship between initial response variability and conditioning in the Kanfer situation.
7. Most S's in the Taffel situation were unaware of the contingency between their response and E's reinforcement.

Microfilm $2.00; Xerox $5.40. 109 pages.

THE GENERALITY AND CONSTRUCT VALIDITY OF EQUIVALENCE RANGE.

(L. C. Card No. Mic 59-5130)

Howard N. Sloane, Jr., Ph.D.
The Pennsylvania State University, 1959

The concept "equivalence range" refers to the range of stimuli an individual will treat as "the same." Previous research has indicated that people are consistent in equivalence range in a variety of tasks involving the sorting of objects, various perceptual constancy situations, and other tasks. The present study was designed to further assess the generality of this concept.

Sixty female Ss were given a battery of 23 measures. Each measure, either due to past research or logical considerations, was potentially a measure of equivalence range. An attempt was made to make explicit some of the ways in which the measures were different from each other.

The intercorrelations of the 23 measures were factor analyzed on PENNSTAC, the Pennsylvania State University digital computer, by the principal components method. The resulting factor matrix was rotated to oblique simple structure using the techniques described by Thurstone.

Of the seven factors extracted, three were felt capable of interpretation. The first factor was called "sorting equivalence range." It characterized something common to all sorting tests, as all sorting tests, and only sorting tests, loaded highly on it. The second factor seemed to relate to the effect of age on certain measures which have been considered measures of equivalence range, and was called "the effect of age." The third factor interpreted was called "associational ease" and seemed relate to the degree to which an individual reports that comparison stimuli fit standard stimuli.

These results were interpreted as meaning that the domain referred to by "equivalence range" is accounted for by at least three factors, each of which has a certain amount of generality. This was discussed in relation to past research and theoretical and practical considerations.

Microfilm $2.00; Xerox $6.20. 128 pages.

AN EXPERIMENTAL EVALUATION OF TWO TECHNIQUES FOR MEASURING INTERPERSONAL RELATIONS IN GROUPS.

(L. C. Card No. Mic 59-4180)

G. Kasten Tallmadge, Jr., Ph.D.
Purdue University, 1959

Major Professor: N. M. Downie

The purpose of the present study was to evaluate a new technique of social measurement recently developed in Australia. The group perception technique, as it is called, was specifically designed to measure existing within group associations whereas sociometry[1], the technique with which it was compared, was designed to measure interpersonal attractions and repulsions.

Although the latter technique was not designed to assess existing associations, it has been widely used for that purpose (Bjerstedt, 1956 a). By comparing group perception and sociometric data, the author hoped to show that the two techniques measured different things and that sociometric data are not highly valid for measuring existing associations.

Two hundred and twenty fifth grade boys from 13 school classes in Melbourne's city and suburban state supported schools and 96 fifth grade boys comprising seven classes from schools in two small midwestern (U.S.A.) towns served as Ss. The following tests were administered: the Australian Council of Educational Research Junior Non-Verbal

Intelligence Test[2], a "Guess Who?" test made up of immaturity, aggression, and dependence scales, a sociometric test, and a group perception test. From the sociometric data popularity scores were obtained for all Ss. Scores for range and mean strength of association were computed from the group perception data.

Using group perception data as criterion measures, it was shown that Ss often do not choose their closest associates. It was further shown that unpopular Ss direct their choices toward others more popular than their closest associates. That group perception data could justifiably be used as criterion measures was indicated when strength of association (as measured by group perception data) was shown to vary systematically with choice preference level. On the basis of these results it was concluded that choices, at least for some choosers, are not valid indicators of existing associations.

Since choices were shown not to correspond to existing associations, it was hypothesized that sociometric popularity (the number of choices received) was not a pure social measure indicating the number of friends Ss had. A factor analysis of correlations among the seven variables mentioned and an accuracy of social perception measure (developed by the author from group perception data) offered support for this hypothesis. Three factors emerged which corresponded respectively to personal adjustment, extent of social interaction, and cognition. Popularity had approximately equal loadings on the adjustment and social factors indicating that choices are determined not only by existing associations but by the personal qualities of the person chosen as well.

A third part of the study demonstrated how the joint use of the sociometric and group perception tests could yield information about those Ss whose social positions differed from one analysis to the other.

All of the above findings were obtained from the Australian data. American data were used to demonstrate that the results were not culturally determined. Although some cultural differences were found, none of them were related to the principal hypotheses of the study.

As a result of the research findings, the group perception technique was recommended for use where structural analysis of groups is the desired goal. The sociometric approach should be used only for measuring interpersonal attitudes. Microfilm $2.00; Xerox $6.00. 122 pages.

1. The author has chosen to use this term in its traditional sense as referring specifically to that technique introduced by J. L. Moreno (1934).
2. Administered only to Australian Ss.

LEARNING FACTORS IN SIZE ACCENTUATION.

(L. C. Card No. Mic 59-4381)

John Wilson Turnbull, Ph.D.
The University of Nebraska, 1959

Advisers: Dr. Katherine E. Baker and
Dr. Don W. Dysinger

An experimental study was conducted in an effort to clarify the problem of why valued objects are accentuated in perceived size. The purposes of the study were to test a learning hypothesis offered to explain accentuation, and to determine the feasibility of investigating perceptual learning in the laboratory. The learning hypothesis states that experimental accentuation is the result of a generalized largeness-reward association which the subject has learned in previous experience, and that this association is responsible for the accentuation of valued objects. It was assumed that building-in different size-reward associations would produce concomitant variations in the perceived size of the stimulus if this explanation were correct.

The procedure was to measure the subjects' size judgments, provide each of six groups with different learning experiences, and then to remeasure size judgments for the effects of learning. Three broad kinds of learning were used. One kind was termed reward-identification learning. Subjects in this condition learned that a cue which was a functional part of the perceptual stimuli signified reward. They learned no new size-reward associations. A second type of learning involved specific and generalized training. Specific training consisted of learning size-reward relations for tokens identical in shape to the perceptual stimulus. Generalized training was the learning of size-reward relations for three other tokens, like the perceptual stimulus only in having the same value cue. Both specific and generalized conditions were divided into smallness-reward and largeness-reward learning.

Sixty boys between $9\frac{1}{2}$ and $11\frac{1}{2}$ years were used in the study. There were 10 in each of the six groups. Each boy was seen on three consecutive days. The method of limits was used for obtaining pre-learning and post-learning size-judgments from slides flashed on a screen. The data were analyzed in terms of difference scores.

The results and conclusions are as follows:

1. The Control Group, a control for stimulus familiarity, changed very little. It was concluded that stimulus familiarity without reward will not produce accentuation.
2. Reward-identification learning produced a significant shift toward accentuation. It was concluded that simply attaching reward value to a stimulus would produce accentuation.
3. Generalized size-reward learning was more effective than specific size-reward learning in affecting size judgments. This was an unexpected result. It was suggested that specific training, with the same shape stimulus used in perceptual tests, may have enabled subjects to dissociate the emotional significance of the stimulus from the size dimension, producing increased accuracy.
4. Smallness-reward learning was more effective than largeness-reward learning in altering size judgments. It was found that smallness-reward learning did reduce accentuation below that found in the reward-identification group for both specific and generalized conditions. Largeness-reward learning did not increase accentuation over that found in the Reward-Identification Group in either specific or generalized conditions. It was suggested that the largeness-reward association learned in "real life" may have been so overlearned that no change was produced by additional largeness-reward learning, while novel smallness-reward learning was effective. It was also suggested that conflicting learning in the study may have reduced the magnitude of predicted changes.
5. The overall results suggest that different learning conditions will produce variations in size judgment. This supports the hypothesis that accentuation is a learned

phenomenon and, more specifically, that a largeness-reward association is responsible for the effect. It was concluded that it is feasible and profitable to study perceptual learning under laboratory conditions.

Microfilm $2.00; Xerox $4.40. 81 pages.

DEVELOPMENT OF A JOB PERFORMANCE CRITERION FOR PRODUCTION FOREMEN.

(L. C. Card No. Mic 59-4183)

Weld Winston Turner, Ph.D.
Purdue University, 1959

Major Professor: Joseph Tiffin

The purpose of this study was to develop a job performance criterion for production foremen. Monthly scores on nine ratings and eleven objective measures were analyzed for two plants.

Monthly scores on the objective measures were ranked within departmental-shift units. Ratings were monthly foremen rankings made by general foremen. All monthly ranks were converted to standard scores. The reliabilities of mean scores based on three, six and nine months were estimated for the measures within each plant. Fifteen criteria in one plant and sixteen in the other plant had reliability estimates of .70 or higher for mean scores from nine months of data.

Mean monthly scores on each criterion measure were computed for the foremen. These scores were converted to percentiles within each plant, then transformed to standard score distributions. The intercorrelations of the transformed mean scores were found for the two plants separately and both plants combined.

The three intercorrelation matrices were factor analyzed and orthogonally rotated into four meaningful factors. Two factors, Job Performance Reputation and Employe Relations, were the same in both plants. The third and fourth factors, consisting of the cost-production-quality portion of job performance, differed in the two plants. Factor III and Factor IV were bipolar in both plants. Factor score equations were developed for reproducing each factor by using factor loadings as the reproducibility coefficients of the variables. Correlations of the factor score equations with the factors ranged from .54 to .95 for predicted factors and from -.12 to .20 for factors not being predicted. The intercorrelations of factor score equations were satisfactorily low and their reliabilities were generally adequate.

Relevancy rankings for the twenty criteria were obtained from eight department superintendents in both plants. The ranks for each rater were transformed to T-scores. Criterion relevancy scores were obtained by ranking the variables according to the mean of their T-scores added across eight raters, then converting the overall rank-order to T-scores. Criterion relevancy scores were distributed among the factors by using the absolute values of the factor loadings as weights. Mean factor relevancy values were used in finding relevancy indexes for combining the factors into a composite criterion. To determine their preferred direction, mean factor relevancies for the bipolar factors were also computed by taking the algebraic signs of the factor loadings into account; it was found that the positive and negative factor relevancies tend to counterbalance each other.

The resulting criterion consisted of equations for independent sub-criteria (orthogonal factors) and relevancy weights for combining the sub-criteria into a composite.

Microfilm $2.00; Xerox $4.40. 83 pages

PSYCHOLOGY, CLINICAL

REPRESSION IN TERMS OF LEARNING THEORY.

(L. C. Card No. Mic 59-5100)

Willard Glenn Conrad, Ph.D.
The Pennsylvania State University, 1959

The Problem

The major purpose of this research was to establish an experimental analogue of repression and in so doing, test several hypotheses derived from Dollard and Miller's theory of repression. These authors view repression as a learned avoidance response and hold that it is learned through reinforcement by drive reduction. The drive reduction responsible for the learning of repression is usually a reduction in anxiety or guilt which accompanies the avoidance response of "stopping thinking about" a painful experience. The problem of lifting repression becomes a matter of extinguishing the anxiety associated with the painful event so that its reduction can no longer reinforce the avoidance response.

The Experiment

Both experimental and control groups underwent a series of six events: (a) Learning; (b) Conditioning; (c) Recall I, followed by a 48-hour interval; (d) Recall II: (e) Extinction; and (f) Recall III.

1. The task involved the learning of paired three-letter nonsense syllables to a given criterion by the method of anticipation. The order in which the individual pairs were learned was taken into account in the comparison of the shock and non-shock groups.

2. The conditioning procedure followed the learning task and involved projecting onto a screen the response members only of each previously learned pair of nonsense syllables. For the experimental subjects the visual presentation of some of the response members was followed by a painful electric shock, whereas, the control subjects experienced the visual presentation but received no shock.

3. After the established number of conditioning trials, the first recall of the previously learned material, Recall I was obtained and a 48-hour interval followed.

4. Following the 48-hour interval the second recall, Recall II, was obtained.

5. Immediately following Recall II, the response members were exposed in an identical manner in which they were presented in the conditioning trials, with the exception that none of the response members was followed by an electric shock.

6. After completing the established number of extinction trials, a third recall, Recall III was obtained.

Three independent variables, level of original learning, number of reinforcement (shock) trials, and number of extinction trials, were manipulated in a 2x2x2 and a 2x2x3 factorial design. The dependent variable was memory for the stimulus members of the paired associates on Recall I, II, and III, and the difference between Recall II and III. Memory for the stimulus members only was used because this measure was free from additional learning trials during the conditioning and extinction procedures, and the effects of shock were manifest through mediated generalization.

Results

There was no significant recall decrement associated with the independent variables of the level of original learning or the number of extinction trials on any of the measures on the dependent variable. There was no significant recall decrement associated with the independent variable of electric shock on Recall I; however, recall decrement occurred on Recall II for all of the experimental groups and was associated with a probability of .055. The effect of extinction was limited primarily to those groups who had previously received shock and analysis of the difference between Recall II and III revealed a recall increment for those subjects which was associated with a probability of less than .01. It was concluded that the association of negative affect with previously learned material had resulted in a recall decrement and that subsequent extinction of this negative affect had resulted in a recall increment. The failure of the independent variables of level of learning and number of extinction trials to produce differential recall was discussed.

Microfilm $2.00; Xerox $5.40. 107 pages.

THERAPIST AND CLIENT EXPECTATION OF PERSONALITY CHANGE AND ITS RELATION TO PERCEIVED CHANGE IN PSYCHOTHERAPY.

(L. C. Card No. Mic 59-5108)

Arnold P. Goldstein, Ph.D.
The Pennsylvania State University, 1959

STATEMENT OF THE PROBLEM

The purpose of the present study was to examine the relationships among clients' expectations of personality change due to psychotherapy, therapists' expectations of client personality change, and other client attitudes and behaviors related to psychotherapy.

VARIABLES

Client attitudes toward the Psychological Clinic were the feelings held by the client toward the ability of the Clinic's personnel to help resolve a variety of personality problems. An instrument titled the Friend's Problem Inventory was constructed as the measure of this variable. Duration of psychotherapy was counted as the number of sessions the client remained in psychotherapy. Client expectation of change was the feelings held by the client relating to the anticipated nature of his problems upon completion of his psychotherapy. This variable, and those discussed below, were measured by a set of Q-sorts developed for this purpose. Client perceived change was the feelings held by the client that change had taken place in the nature of the problems to which he had previously admitted. Therapist expectation of client change was the therapist's anticipations regarding his client's problems upon completion of the latter's psychotherapy.

PROCEDURES

Clients were randomly assigned to the experimental (therapy) or control (no-therapy) groups. Experimental clients were randomly assigned to therapists. Therapists met their clients twice weekly for 50 minute interviews. All clients completed the FPI and the Q-sorts before therapy commenced. Re-sorting of the Q-sorts took place after every five sessions for the experimental clients and after every two and one-half weeks for the control clients. The therapists completed the sortings after every five sessions.

RESULTS AND CONCLUSIONS

A correlational analysis was used in this experiment. This analysis suggests the following conclusions.

No significant relationship was found between:

1. Clients' initial expectations of personality change and clients' attitudes toward the Psychological Clinic.
2. Duration of psychotherapy and the clients' attitudes toward the Psychological Clinic.
3. Duration of psychotherapy and either therapists' or clients' expectations of client personality change.
4. Clients' expectations of personality change and clients' perceived personality change.
5. The degree to which clients' expectations of personality change are confirmed and subsequent changes of clients' expectations of personality change.
6. Therapists' expectations of client personality change and either clients' expectations of change or clients' perceived change.

A significant relationship was found between:

1. Duration of psychotherapy and the joint effect of therapists' and clients' expectations of client personality change.
2. Changes of clients' expectations of personality change and the joint effect of therapists' expectations of client personality change and clients' expectations of change.

Post hoc analysis of a portion of these data revealed:

(1) The therapists for those clients whose expectations of change increased over therapy expected significantly more client change at the fifth session than did the therapists for those clients whose expectation of change decreased.

(2) The therapists for those clients who perceived positive change in themselves over therapy expected significantly more client change at the fifteenth session than did the therapists for those clients who perceived negative change in themselves.

Microfilm $2.00; Xerox $6.20. 129 pages.

EFFECTS OF FAILURE ON PERFORMANCE OF HIGH AND LOW "MANIFEST ANXIETY" GROUPS IN A TRANSFER TASK SITUATION.

(L. C. Card No. Mic 59-4638)

Marvin S. Kivitz, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. William Shaw

This study was undertaken to investigate the relationship between scores on the Taylor Manifest Anxiety Scale (MAS) and tendency to utilize repressive defenses. Deese and Eriksen suggest that Ss scoring low on the MAS are more prone to use repressive defenses than high scorers. In contrast to this, predictions formulated on the basis of an MAS Anxiety Repression analysis indicated that high scorers rather than low scorers should be expected to exhibit greater repressive tendencies. These conflicting predictions made it necessary to determine whether HA or LA Ss is an ego-threat situation exhibited more repressive tendencies.

In order to test the applicability of each of these positions, a negative transfer procedure developed by Rutman was employed in the belief that it provided the most sophisticated technique for demonstrating and evaluating experimental repression. The transfer tasks utilized consisted of two series of six letter words to be decoded. Basic components and rules for decoding were the same for both tasks. The difference between the tasks consisted in the order with which a given component was associated with a particular decoding rule. It had been previously found that when these series were administered in sequence, they produced negative transfer effects.

The subjects were 48 female undergraduate students who scored in the upper or lower 20 per cent of the score distribution on the MAS. These "High Anxiety" (HA) and "Low Anxiety" (LA) groups were each divided at random into an experimental and control group. There were four groups in the experiment. The decoding tests were represented to Ss as part of a scholastic abilities test. All Ss worked on the first decoding task until criterion was achieved. At this point experimental groups were given fictitious failure instructions concerning performance. Control groups were given no information concerning quality of work. An additional trial of the first decoding test was given to all groups. Experimental groups were again advised of failure. All groups then performed on the transfer task (second decoding test) until criterion was reached. Experimental groups were now advised of the false nature of failure instructions. One additional trial on the second decoding test was given to all subjects. To control for possible changes in motivational level, a digit symbol test was given to all Ss at the beginning of each of the four parts of the experiment.

Results revealed that the LA control group exhibited significant negative transfer between the first and second decoding tasks. All other groups exhibited significant positive transfer. The LA experimental group took significantly fewer trials (exhibited more positive transfer) to reach criterion on the transfer task than the HA experimental group. There was no significant difference in transfer effect between the HA experimental and HA control groups. After disabusal of failure both experimental groups (HA and LA failure groups) took significantly longer on the additional trial of the second decoding test than did the control groups. After disabusal of failure there were no significant differences between the HA and LA experimental groups or between the LA and HA control groups.

Findings were interpreted as being most adequately accounted for in terms of a repression analysis. In conjunction with previous work, this study suggests that a process akin to repression is demonstrable in the laboratory. Analysis of experimental data from an MAS Anxiety-Repression standpoint and a pure drive theory interpretation proved inadequate in accounting for obtained data. Evaluation with reference to the Child, Mandler, Sarason relevant-irrelevant response position revealed several inconsistencies between predicted and obtained results. Results were interpreted as being in accord with predictions derived from the theoretical position of Deese-Eriksen. This study adds additional support to the view that in an ego-threat situation LA Ss display more tendency to utilize repressive defenses than HA Ss. It is suggested that scores on the MAS must be considered a measure of a personality variable related to the way individuals respond or defend themselves from anxieties.

Microfilm $2.00; Xerox $3.00. 57 pages.

CLEARNESS OF COMMUNICATION IN RELATION TO EMOTIONAL DISTURBANCE AND TO PSYCHOTHERAPY.

(L. C. Card No. Mic 59-4531)

Thomas Hollister Lynch, Ph.D.
University of Illinois, 1959

This study concerned the clearness of communication of emotionally disturbed persons both before and after psychotherapy. Communication involves the transmission of a message from an encoder to a decoder. When the message's elements have common meanings for the encoder and the decoder, and when the elements come in sequences the decoder has learned to expect, the decoder will clearly decode the message. Clearness of communication therefore depends on the degree of correspondence between encoding habits and decoding habits.

Many therapists assume that emotionally disturbed persons alleviate their anxiety through reduction of awareness of factors which would be a threat to values held essential to existence as a personality. Verbal material related to the self-concept was construed as central to such values and therefore a disturbed client should be unclear in his communcation about his self-concept and more clear about a concept relatively remote from central values, a nonself-concept. Since psychotherapy presumably reduces threats to the self-concept, a client should communicate more clearly about his self-concept after psychotherapy but clearness of communication concerning a relatively nonself-concept should not change.

Clients of a university counseling service produced messages in the Gilbert Self Interview, where they talked about nonself (Card 5) and self (Cards 7 and 8) areas. Clearness of communication was assessed by the cloze procedure, i.e., the messages were mutilated by removing some words and then judges were asked to try to supply the missing words. Nonclinical and clinical judges were used.

No important differences between these two groups as judges were noted, and the cloze procedure proved to be a reliable method.

The judges also rated the ease with which they supplied the missing words, and the ease ratings correlated significantly with cloze scores. This agreement validated the cloze procedure in the sense that a "clear" message should be one in which a decoder can easily decode despite gaps in a message.

The findings did support the hypothesis that the more a person is emotionally disturbed, the less clear his communication about his self-concept. However, this was also found for nonself clearness, and therefore the expected contrast was not found. The findings regarding changes with psychotherapy indicated there was no average change for the entire group for either nonself or self clearness. There were also no marked indications that the degree of change of either nonself or self clearness was related to the degree of successful therapeutic outcome.

The group of clients was subdivided by emotional disturbance ratings and by therapeutic movement ratings. In the low disturbance subgroup the nonself clearness was greater than the self clearness while this was less so for the high disturbance subgroup. Clients with more successful therapeutic ratings increased their nonself clearness while the less successful decreased.

One explanation for these additional results is that severely emotionally disturbed clients are threatened in talking about problems even in the "nonself" area because severe disturbance involves widespread repression in many areas of life. With less severe disturbance, nonself clearness should be more clear, and after successful psychotherapy a client should be more clear in the nonself area. However, it was noted that the results were not pronounced and gave only weak support to this explanation. An alternative explanation is that emotional disturbance is accompanied by unclear communication in a person's verbal expression whenever he talks about any sort of problem, i.e., the distinction between nonself and self problem areas in regard to evoking emotional disturbance is not a significant one. However, low correlations between nonself and self clearness, both before and after psychotherapy, make this explanation inconclusive.

Microfilm $2.00; Xerox $5.40. 108 pages.

COUNSELING AND GUIDANCE SERVICES FOR STUDENTS AFFECTED BY A UNIVERSITY SELECTIVE ADMISSION POLICY.

(L. C. Card No. Mic 59-4315)

Robert H. Mattson, Ed.D.
University of Oregon, 1959.

Adviser: Raymond N. Lowe

The general purpose of this study has been the development and evaluation of a program of counseling and guidance services for students affected by a university selective admission policy.

The selective admissions policy as it relates to the study is discussed in the introductory chapter. The counseling program as developed, included both individual and group counseling. The counseling staff included counselor-trainees as well as regular university counseling center staff members. Separate chapters on the counseling program, and administration and staff were included in the thesis. Theory and practice, related to counseling procedure and admission policy in the program, were discussed in a separate chapter.

Fourteen students affected by the selective admission policy were admitted to a trial summer session academic program. The fourteen students were offered the counseling services in addition to the academic program. The goals, in counseling the group of fourteen students, were defined in terms of movement toward maximum utilization of the individual's potential. Continuation in college was not a primary goal.

The specific immediate goals in counseling the students involved orientation and movement toward the following:

1. Familiarity with University practices and resources. Emphasis was on student personnel services; the counseling program, the services and practices of the Dean of Men and Dean of Women's offices, and the advising services of individual faculty members.

2. Growth toward effective study skills and practices. Individual study skills and practices were assessed and remedial counseling and instruction given when indicated.

3. Sensitivity to the need for systematic rational career planning. The nature of careers, why people work, the complexity of interest, aptitude, training, and personal factors involved in career planning were explored. The emphasis in this area was on the individual and depended upon the assessment of each individual.

4. Increased understanding of educational resources as they relate to particular goals. Schools, colleges, technical institutes, various curricula, apprenticeships were considered when assessment results indicated appropriateness.

5. Development of a rational approach to problem solving. Individual students were given support and encouragement to learn as much as they could about themselves and the situations in which they operate and to approach decision-making logically.

6. Development toward compassionate interpersonal relationships. Compassionate interpersonal relationships were defined as relationships in which there is a strong bond of feeling--a mutual willingness to explore and express impulses, tensions, and feelings. The term compassion was used in preference to empathy or acceptance because the latter terms tend to imply a passive relationship between a superior and an inferior.

The counseling and guidance program included a comprehensive variety of information gathering techniques. Five tests were used: Strong Vocational Interest Test, California Study Methods Survey, California Psychological Inventory, The Ohio State University Psychological Test, and The Sequential Tests of Educational Progress. Interviews and observations were also used to collect information about the clients.

The information compiled on each client was successfully utilized in counseling, but provided no better basis for predicting academic success than academic aptitude test scores and high school grades.

Evaluation of the counseling program was based primarily on analysis of case summaries. Each case was treated separately and analyzed for change related to the immediate counseling goals. Counselor ratings and client ratings were also utilized in the evaluation of the program.

Analysis of case summaries indicated definite change, in directions consistent with the counseling goals, in eight of the fourteen clients. No significant change in the remaining six clients was observed.

The clients' ratings of the program were quite consistently and strongly positive, and the counselors' ratings of the program were unanimously strongly positive.

The program, evaluated in terms of client change, client rating, and counselor rating, was viewed as generally beneficial to the clients.

Microfilm $2.10; Xerox $7.40. 157 pages.

CONDITIONS OF IDENTIFICATION FAILURE IN NEUROTIC BOYS.

(L. C. Card No. Mic 59-4538)

Arnold Lee Miller, Ph.D.
University of Illinois, 1959

This study tested O. H. Mowrer's hypotheses relating neurosis to ambivalent identification with the same-sex parent. This identification failure is said to result when parents do not encourage the child to identify, and is associated with marital dissatisfaction. Identification failure, and the family dynamics producing such a failure, are related to Mowrer's theory that neurosis, essentially, is due to an ambivalent assimilation of superego. This view is opposed to Freud's theory that neurosis is associated with too "severe" moral standards.

The hypotheses are that marital dissension between the parents of neurotic boys prevents the mother from encouraging the boy to give his allegiance to the father, that the father of the neurotic boy does not promote identification, and that the son of such parents has an ambivalent identification with his father. It was also expected that mothers do not encourage clear-cut sex-role identification in their sons.

The parents of 20 boys (ages six to 12) referred for treatment of an emotional problem at a psychological clinic were compared to both parents of 20 boys adjudged by their teachers to be free of emotional problems. The parents in each group were paired on the basis of socio-economic level, and did not differ with respect to age, education, years married, number of children, or hours away from home. Their sons did not differ in age or school grades.

Parents and sons of both groups were tested in their homes. The parents rated, on Osgood's Semantic Differential, concepts such as MY MARRIAGE and THE IDEAL MARRIAGE. On a 60 item list, they also indicated which jobs, interests, and amusements they would encourage their sons to like when he grew up, and which interests they themselves preferred. The boys in each group were asked to complete stories based on six TAT cards, the stories concerning father-son relations. Two judges rated the degree to which the boy was unambivalently aligned with his father. The D statistic was used to assess overall profile similarity, on the Semantic Differential, between concepts such as MYSELF and MY SON.

The results show that both parents of the neurotic boy perceive marital dissension. The father is critical of his wife as a wife and mother, while the mother has a low opinion of her husband. Such mothers tend to encourage a confused sex-role identification, but contrary to expectation, do not differ from mothers of problem-free boys in the extent to which they promote identification with the father. The father does not encourage his son to identify, and the less the father encourages such an allegiance, the more emotional problems the boy has. The boy from such a family has less of an identification with the father than does a problem-free boy.

The results suggested that family conflict exists in the home of the neurotic boy, in that neither parent has a fully satisfying relation with their spouse, and the father rejects his son. The son reflects parental conflict in his weak identification with the father and his reluctance to accept paternal standards, which results support Mowrer's theory that the neurotic has a confused allegiance to the same-sex parent, and weaken Freud's view that the neurotic has too "severe" a superego. The results of this and other studies of identification in maladjusted subjects indicate that the neurotic identifies fully with neither parent.

Microfilm $2.00; Xerox $6.00. 124 pages.

THE EFFECT OF BRAIN DAMAGE UPON SENSORY AFTEREFFECTS.

(L. C. Card No. Mic 59-4862)

John Robert Newbrough, Ph.D.
University of Utah, 1959

Chairman: M. Duane Bown

The purpose of this study was to ascertain the effects of brain damage upon sensory functioning. The study was designed to measure figural aftereffects as described by Satiation Theory (Kohler and Wallach, 1944). Divergent results were predicted by the cortical conductivity theory of Krech (Klein and Krech, 1952), and the metabolic efficiency theory of Wertheimer (1956).

Krech (Klein and Krech, 1952) thought that low cortical conductivity was a characteristic of brain damage and led to a rapidly developing large, long persisting FAE's.

Wertheimer (1956), on the other hand, associated low metabolic efficiency with low cortical conductivity and brain damage and predicted that this should result in slowly developing, small, long persisting FAE's.

A battery of ten psychophysical techniques measuring visual, auditory, and kinesthetic functions were combined into a battery. The battery was administered to 10 brain damaged, 10 psychotic and 10 normal VA hospital patients.

The data were analyzed by complex analysis of variance as well as by simple analysis of variance and chi-square. Groups effects on tests were found to be significant at the .05 level. Groups effect alone was significant only at the .10 level. Analysis of the individual tests indicated that auditory flutter fusion significantly differentiated the brain damaged from the psychotic and normal groups. This showed that the difference limen was larger for the brain damaged Ss, and as a group they demonstrated lowered discrimination abilities.

Individual differences were not a significant effect in this

study, although they were expected. The F- ratio obtained for subjects was essentially unity indicating the lack of differing effects in either the numerator or denominator. It was hypothesized that this reflected a total lack of relationship among the various tests within each individual. The relationships obtained were seen to be entirely a function of the grouping effect.

From these conclusions, it was speculated that there exists no basic relationship among sensory functions, and that the correlations obtained by Wertheimer (1956) were an artifactitious relationship imposed by extrinsic factors or conditions (e.g. brain damage).

Wertheimer's theory and data were examined and it was concluded that his logic was incorrect. All he showed was that various processes are related to figural aftereffects. These relationships were concluded to be artifactitious and not as a result of cortical satiation.

A theory of metabolic functioning was seen to be a profitable approach, but Wertheimer's system seemed too vague. A homeostatic system based on the mass law of physical chemistry was offered as a more definitive approach (Porter, 1959).

Krech's theory and data were examined, and it was shown that his system is useless because the predictions do not particularly follow from the system, and that they do not fit data.

It was generally concluded that the tests used in the battery were reliable, and that the selection of Ss on satiation theory principles led to the lack of results. More careful grouping of the Ss was seen to be necessary for further study, and perhaps should be attempted on a dysfunction criteria not a structure-function dichotomization.

Refinements of the various tests in the battery were also suggested. Microfilm $2.00; Xerox $4.80. 92 pages.

CLINICAL USE OF THE SOUND TEST WITH BLIND ADULTS.

(L. C. Card No. Mic 59-4171)

May Husni Palacios, Ph.D.
Purdue University, 1959

Major Professor: John M. Hadley

The Sound Test, an auditory projective technique, was used as a part of a larger research project designed to study variables related to the vocational success of blind adults. The Sound Test consists of a series of 15 sound segments depicting human and mechanical sound situations. This test was individually administered, and the responses were recorded verbatim. Six scoring categories were isolated and defined. They are: (1) Units of thought, (2) Concept formation, (3) Parts of the sound responded to, (4) Integration, (5) Verbalization, and (6) Identification.

Reliability of scoring was determined by the percent of agreement between the writer's first and second scoring of 20 randomly selected protocols. In addition, three qualified judges scored two complete composite protocols. Both the percent of agreement between the writer's first and second scoring, and that among the judges, were sufficiently high to indicate high reliability of scoring.

The population studied was divided into three employment criterion groups: (1) Employed in outside competitive industry (outside), (2) Employed in sheltered workshop (shop), and (3) Unemployed. Two hundred and twelve legally blind adults between the ages of 20 and 50 served as subjects. For the purpose of cross validation, the outside and the shop samples were divided into a primary and a holdout group. There was no holdout group for the unemployed due to the small number of subjects in that sample.

All protocols were scored according to the six scoring categories. Analyses of variance with repeated measures and t tests were computed for each of the six scoring categories, across the three criterion groups. The same statistical analyses were applied to both the primary and holdout group.

In dealing with the sound segments, the outside group produced more units of thought than the shop and the unemployed groups. The responses of the outside sample were indicative of a higher level of organization and integration. This group was more capable of dealing with the whole sound segment, and they demonstrated the ability to reconcile contradictions and to emerge with meaningful associations. They also seemed more able to relate feelings, attitudes, and personal experiences than either the shop or the unemployed groups.

The shop sample seemed to be more satisfied with a lower degree of abstraction and integration. Their responses were usually short and terse. This criterion group experienced some difficulty in freely expressing feelings, attitudes, and personal experiences. The shop sample tended to be more stimulus bound, capitalizing on details in rendering their responses meaningful. In general, the shop sample tended to reject more stimulus situations.

The unemployed sample proved to be significantly different from the outside and the shop sample. This group tended to reduce the sound segment into its simplest components; they named its parts, thereby exhibiting little or no effort to organize and integrate.

The results indicate that the Sound Test is a meaningful technique, and that the three employment criterion groups can be differentiated on the basis of the six scoring categories of the Sound Test.

Microfilm $2.00; Xerox $5.00. 98 pages.

AN INVESTIGATION OF THE PERFORMANCE OF BRAIN-INJURED CHILDREN ON CERTAIN PERCEPTUAL TASKS.

(L. C. Card No. Mic 59-4176)

Mary Evans Robinson, Ph.D.
Purdue University, 1959

Major Professor: John M. Hadley

A survey of the literature relating to the diagnosis of brain damage through the use of various psychological tests is presented. It is noted that the majority of research has been done with adult subjects, or with mentally retarded children, and only infrequent use has been made of an emotionally disturbed criterion group in spite of the often made observation that it is sometimes difficult to

distinguish the behavior of an emotionally disturbed child from that of a brain-damaged one.

The subjects were sixty children of from seven to twelve years of age. Twenty subjects were in each of three criterion groups: the brain-injured group which consisted of children with known neurological pathology; the emotionally disturbed group which consisted of children diagnosed as having varying psychoneurotic symptoms; and the normal group who, on the basis of history and description of present functioning, showed no evidence of the disorders represented in the clinical groups. The three groups were matched for chronological age, mental age, Stanford-Benet I.Q. and distribution of race and sex.

The experimental tests proposed represented two adaptations of the Lowenfeld Mosaic Test. After producing a spontaneous Mosaic as suggested by Lowenfeld, the children were asked to produce an assigned topic and finally to copy a Mosaic provided by the examiner. It was hypothesized that while there be no meaningful intergroup difference on the spontaneous Mosaic, the brain-damaged children would perform at a significantly lower level than the criterion groups on the assigned Mosaic and Mosaic from copy.

In order to compare the discriminatory value of the proposed tests with other diagnostic tests whose value in the diagnosis of brain-damage had already been demonstrated, subjects were given the Goldenberg version of the Ellis Visual Designs and the Peg Board Test, a modified version of the Marble Board Test suggested by Kephart.

Tests results were analyzed to determine which of the tests was most sensitive to group differences and cut-off points were established in order to evaluate the efficiency of the tests in predicting the group membership of individual subjects. The original hypothesis was supported. While there were no significant differences between the three groups in the quality of the spontaneous Mosaic production, there were significant groups differences in their ability to reproduce the assigned Mosaic and Mosaic from copy. In comparison with the criterion tests, the Mosaic from copy was almost as efficient as the Peg Board Test in predicting the group membership of individual subjects. While the assigned Mosaic showed group differences in terms of the total number of pieces used, an effective cut-off point could not be established.

In conclusion it was stated that the Mosaic from copy represented a worthwhile screening procedure for the diagnosis of brain-damage in children within the age range included in the experiment.

Because of differences in the performance of individual subjects on the several tests, it was speculated that while the tests all involved reproduction of design, that the skills needed for successful reproduction varied with the individual tests.

Certain speculations were made as to the significance of the false positive and false negative subjects.

Suggestions for further research indicated the need for the administration of the experimental tests to a larger group of children and more rigorous standards in the selection of the criterion groups.

Microfilm $2.00; Xerox $5.20. 101 pages.

BEHAVIORAL MODIFICATION AS A FUNCTION OF EXAMINER REINFORCEMENT AND SITUATIONAL VARIABLES IN A PROJECTIVE TESTING SITUATION.

(L. C. Card No. Mic 59-4867)

Lawrence David Simkins, Ph.D.
University of Houston, 1959

The purpose of this research was to study the behavioral effects of certain contingent stimuli emitted by the examiner in a projective testing situation. The dissertation was divided into two separate investigations. The first investigation was concerned with determining what dimension of an inkblot test (content, location, or determinants) was the most sensitive to reinforcement and also comparing the effects of strong and weak quality reinforcement. Strong quality reinforcement consisted of the examiner's saying "good" or "that's fine" to a particular response in the class of responses the experimenter had decided to reinforce. Weak quality reinforcement consisted of the examiner's nodding his head and saying "mm-hm." This part of the research was referred to as Study I.

The second part of the investigation was concerned with situational variables and their relationship to examiner reinforcement. Thus, it was expected that under anxiety producing situations the effects of examiner reinforcement would be accentuated. This part of the research was referred to as Study II.

The procedure for Study I was as follows: Volunteer subjects from introductory psychology classes at the University of Houston and student nurses at the University of Texas Medical Branch were used. The Holtzman inkblot cards were administered to each subject. The subject was requested to give two responses per card. An inquiry for location and determinants followed each response. There were five testing sessions. A total of fifteen cards were administered at each session. A control group was given the entire set of inkblots with no reinforcement. The experimental subjects also went through the first and last session with no reinforcement. Two experimental subjects were matched on the basis of having the same initial operant level in the class of responses that the examiner had decided to reinforce. In the middle three test sessions both subjects received reinforcement for that class of responses; one subject received weak quality reinforcement and the other strong quality reinforcement.

At the end of the final testing session each subject was requested to complete an anxiety rating scale in order to determine how much tension they felt during the testing. They were also administered a questionaire designed to determine whether or not they were aware of the reinforcement, were able to verbalize the reinforcement contingency, and thought they were influenced to give a greater number of responses in that particular class as a function of the reinforcement.

The matched control subjects were selected from a pool of control subjects. These subjects had approximately the same initial operant level in the response class that the examiner had decided to reinforce, as the two experimental subjects. The number of subjects making up a particular matched control varied, depending upon the number of control subjects who had the same initial operant level as the experimental subjects. The means of the matched

controls were used as the data for making statistical comparisons with the experimental subjects.

The results of Study I were as follows:

1. The content dimension showed the largest reinforcement effects followed closely by the determinant dimension.
2. The location dimension was the most resistant to change as a function of reinforcement.
3. There was no difference between strong and weak quality reinforcement; if anything, weak quality reinforcement was slightly more effective than strong quality reinforcement. This relationship held for all inkblot dimensions. Both strong and weak reinforcement were significantly effective in producing change when compared to the matched control subjects.
4. The content dimension subjects were significantly more aware of the reinforcement procedure than either the location or determinant subjects. There were no differences in awareness between strong and weak quality reinforcement subjects.
5. The experimental subjects rated themselves as having significantly more anxiety than the matched control subjects. There were neither differences in anxiety between experimental subjects dependent upon inkblot dimension nor between strong and weak quality reinforcement subjects.

The purpose of the second part of the dissertation was to study the interactions that occur between certain situational variables and vulnerability to weak quality reinforcement. Subjects were selected from the pool of control subjects and matched with pairs of new experimental subjects on some content category. Only content categories were selected for reinforcement in this part of the research inasmuch as the results from Study I showed this dimension to be the most sensitive to reinforcement effects. One subject from each experimental pair was reinforced under test instructions that involved a positive set. That is, he was told the test that he was about to take measured creativity and that he was to do his best. The other experimental subject with whom he was matched received negative set instructions in which he was told that the test measured a "neurotic potential." The control subjects were considered as a neutral set in the sense that they were simply told that this was a new inkblot test with which the examiner was doing some exploratory research. They were also told that the examiner was not particularly interested in personality variables at this time. Only weak quality reinforcement was used in this phase of the research. With the exception that only content categories and weak quality reinforcement were used, the design for Study II was the same as the design in Study I. These subjects also received an awareness level questionnaire and an anxiety scale at the end of the final testing session.

Separate control data was collected on a group of subjects who received the experimental set instructions but who did not receive reinforcement. These subjects were referred to as the set control group. The set control group consisted of six subjects; three subjects received negative set instructions and three subjects received positive set instructions. The reason for collecting data on this group was to make sure that there were no strong effects as a function of set alone, independent of the reinforcement. The set control group was compared with the control group from Study I on the content category classes chosen for reinforcement in Study II. There were no significant differences between these two control groups, thus any effects produced by the experimental subjects in Study II are probably a function of the instructional set and reinforcement rather than to the instructional set alone. The major findings of the second study were as follows:

1. There were significant differences between the negative and positive set experimental subjects. Under positive set instructions weak quality stimuli had the effects of positive reinforcers. Under negative set instructions weak quality stimuli had a punishing effect producing a decrease in the reinforced category. Only tentative conclusions, however, could be drawn with respect to the negative set group. Although there was a statistically significant decrease in the reinforced categories, the absolute amount of change was small. The initial operant level was chosen in such a way as to demonstrate clearly the effects of positive reinforcement but was too low to show definite punishment effects. Also, in one of the categories chosen for reinforcement, the set control group decreased almost as much as the mean decrease of the negative set experimental subjects. However, the fact that all negative set experimental subjects showed a change in the expected direction gives encouragement to do further research along these lines.
2. There were no significant differences between content subjects receiving weak reinforcement in Study I and the positive set experimental subjects in Study II. There were also no significant differences in anxiety scores and awareness scores between weak content subjects of Study I, negative set subjects Study II, and positive set subjects Study II. Therefore, definite conclusions could not be drawn with respect to Study II inasmuch as it is not known whether reinforcement effects are accentuated under anxiety producing situations or whether this was simply an experimental failure in producing anxiety. It was speculated that the experimental subjects in this study were more anxious in the earlier stages of the testing, but, as the testing progressed, adaptation produced a diminution in the subjects' anxiety level. Future research in this area, involving the use of an extended series of testing sessions, should include techniques that will maintain the anxiety level. Further implications of this study for future research were then considered.

Microfilm $2.55; Xerox $8.80. 194 pages.

A STUDY OF CRITERIA USED TO DIFFERENTIATE THE HUMAN-FIGURE DRAWINGS OF NORMALS, NEUROTICS, AND PSYCHOTICS.

(L. C. Card No. Mic 59-4187)

Edward J. Wallon, Ph.D.
Purdue University, 1959

Major Professor: Mark Stephens

This study had as its purposes 1) to test the validity of the DAP technique as an index of broad levels of adjustment and 2) to determine what cues are most effective in contributing to its use in this manner as well as to ascertain which cues are detrimental in this respect.

The subjects consisted of a group of normal, a group of neurotic, and a group of psychotic male, adult veterans. There were 25 subjects in each group. A drawing of a male and of a female figure was secured from each subject. The 75 sets of drawings were arranged in random order and presented to 5 experienced clinicians for assigning to the three diagnostic categories. Four of the five judges achieved a number of successes which exceeded chance at or beyond the .03 level of probability; collectively, they exceeded chance at the .001 level. Despite this, less than half the judgments for any given judge, were in agreement with the criterion.

The frequency with which various cues were associated with both correct and incorrect judgments was obtained. Both types of cues were discussed in the light of other experimental studies relating them to the same diagnostic categories that were employed in this study. The number of cues associated with accurately, versus inaccurately, identified drawings was compared and no significant difference was found between the two. There was, however, a significant relationship between the number of cues given to a drawing and the type of diagnostic rating which was assigned to that drawing: the fewest number of cues was associated with "normal" ratings and the greatest number with judgments of "psychotic." The judges showed more confidence about making ratings of "normal" or "psychotic" than about judgments of "neurotic" but, as with the number of cues, confidence in the ratings was no greater for accurately judged drawings than for inaccurately judged drawings. Microfilm $2.00; Xerox $5.00. 97 pages.

THE CONDITIONING OF VERBAL BEHAVIOR WITH NEGATIVE CULTURAL CONNOTATIONS.

(L. C. Card No. Mic 59-3657)

Meira Ellen Zedek, Ph.D.
Boston University Graduate School, 1959

Major Professor: Professor Chester C. Bennett

This study deals with two main problems: the effect of positive reinforcement on verbal behavior with negative cultural connotations, and the relationship of awareness of the reinforcement contingency to personality and performance variables.

The specific hypotheses tested in this study are:

1. The frequency of verbal behavior that has negative cultural connotations increases when the behavior receives positive reinforcement.
2. The degree of awareness of the reinforcement contingency is inversely related to level of anxiety.
3. The degree of awareness of the reinforcement contingency is directly related to measures of interpersonal skill.
4. The increase in frequency of verbal behavior that has negative cultural connotations is not related to awareness of the reinforcement contingency.
5. The degree of awareness of the reinforcement contingency is inversely related to length of response time.

Verbal behavior with negative cultural connotations was operationally defined as verbal responses connoting aggression. The verbal stimulus "Hm Mm" was used as reinforcer. Awareness was defined as the verbalization of the contingency of the reinforcement on verbal response connoting aggression. Anxiety was defined as scores on the Taylor Manifest Anxiety Scale (TMAS). Measures of interpersonal skill were defined as scores on five scales of the California Psychological Inventory (CPI): Social Presence, Self Acceptance, Dominance, Capacity for Status, and Sociability.

To test the first hypothesis, an experimental group consisting of thirty-nine subjects and a control group consisting of twenty subjects were given a word association test, consisting of fifty aggressive and fifty neutral words. The subjects were asked to say three words in response to each stimulus word. From the twenty-first stimulus word on, the subjects in the experimental group received reinforcement whenever they gave an aggressive response. The control group did not receive this reinforcement. The responses were recorded and timed. Response time consisted of the time the subjects required to give three response words to each stimulus word. The two groups were then compared with regard to increase in frequency of aggressive responses.

To test the remaining four hypotheses, the experimental group was interviewed to ascertain the presence or absence of awareness of the reinforcement contingency. The group was divided accordingly into two groups, the aware group consisting of sixteen subjects and the unaware group consisting of twenty-three subjects. These two sub-groups were given a questionnaire containing items from the TMAS and the five scales of the CPI. The groups were then compared with regard to scores on this test measuring level of anxiety and interpersonal skill. They were also compared with regard to level of conditioning, as measured by the increase of aggressive responses to the word association test, and with respect to response time scores.

The experimental findings supported the first hypothesis and indicated that the frequency of occurrence of verbal behavior with negative cultural connotations increased when the behavior was reinforced.

With regard to the hypotheses dealing with awareness, the results supported the second and third hypothesis and showed that degree of awareness was inversely related to level of anxiety, and directly related to measures of interpersonal skill. High degree of awareness was associated with low level of anxiety and vice versa. High degree of awareness was also associated with high level of social presence and self acceptance and vice versa. The

experimental findings concerning the relation of awareness to personality variables such as dominance, capacity for status, and sociability, were in the predicted direction but the statistical analysis of the results did not demonstrate population differences.

The results also supported the fourth hypothesis and indicated that degree of awareness was not related to level of conditioning, it was, however, related to overall response level.

The hypothesized relationship between degree of awareness and length of response time was not supported by the experimental results.

Microfilm $2.00; Xerox $5.40. 108 pages.

PSYCHOLOGY, EXPERIMENTAL

CONSISTENCY OF COLOR USAGE AND SOME CORRELATES.

(L. C. Card No. Mic 59-4123)

Dale Leroy Allred, Ph.D.
Purdue University, 1959

Major Professor: L. M. Baker

This study was designed to investigate the consistency with which persons respond to or use color in different situations, and some factors which may be related to the color usage. Fifty male neuropsychiatric hospital patients were given the Rorschach test and the task of making three drawings using colored chalks. The drawings were rated on a five-point scale the values of which ranged from one which signified use of form only without color on a continuum through to five which signified use of color only with no regard for form or representation of objects. This scale is comparable to Rorschach's system of scoring determinants as F, FC, CF, and C. These scores were combined for the three drawings to give a form-color score which reflected the degree to which subjects used color in the drawing task. Non-directive instructions were given in this task so the subject was free to use or not to use chromatic color as he chose, and instructions avoided any suggestion in the direction of color usage.

The form-color score was related to several Rorschach factors: ΣC, $\Sigma C/R$, ΣY, $\Sigma Y/R$, number of responses, and number of content categories used. The first four factors were selected to investigate the consistency with which color was used in the two situations, the Rorschach where only a "passive" response to color was required, and the drawing where a "dynamic" or "expressive" use of color was necessary. The other two factors, R and number of content categories, were used to test a hypothesized relationship between color usage and a general responsiveness to external stimuli.

The form-color scale which was used was checked for reliability by having three judges rate 45 pictures. A reliability coefficient of .85 was obtained using an analysis of variance. The Rorschach factors were compared to the form-color scores using biserial correlation. Statistical analysis was descriptive rather than inferential. All relationships were positive and significant to at least the .05 level.

Within the limitations of this study there is no justification for rejecting the hypothesis that there is a generalized color response and that this color response is associated with a general responsiveness to external stimuli.

Microfilm $2.00; Xerox $3.60. 62 pages.

INTRAMODAL AND HETEROMODAL ANCHOR EFFECTS IN THE ABSOLUTE JUDGMENT OF DURATION.

(L. C. Card No. Mic 59-3528)

Isaac Behar, Ph.D.
Emory University, 1959

The main purpose of the present study was to investigate intermodality similarity-relationships by comparing the shift of subjective scales of duration with intramodal and heteromodal anchors. In addition, other aspects of anchoring and of the judgment of duration were investigated.

While five relatively independent experiments were conducted, in each of these the method of single stimuli was used, with a standard series of arithmetically spaced filled-intervals of one to five seconds. Judgments were referred to an eleven-category scale. Two modalities, vision and audition, were compared. Anchor durations, when presented, were not identified in any special way; they were included as a series member (but with somewhat greater frequency) and were also judged.

In the first experiment, twenty-four subjects judged the standard series alone, and with the inclusion of a 0.2- and nine-second anchor. The order of presentation of the three conditions was counterbalanced by random assignment of four subjects into each of the six possible sequence groups. All durations were presented visually. The results of this study were analyzed in two ways and compared. When the mean judgments of the standard series in each condition were obtained by averaging without regard for the order of presentation, the shifts effected by the inclusion of the anchors were minimal and barely reliable. A significant difference was observed for the six sequence groups, and for the conditions-by-sequence interaction, suggesting that the frame of reference derived in one condition persists in the following conditions. This view is strongly supported by a comparison of these results with those for the first condition only. Here, the differences between anchor groups are quite pronounced and highly reliable. The results of this comparison stress the importance of using independent groups of subjects in each condition if the anchoring effects under study are not to be confounded by cumulative effects.

The second experiment had three purposes: (1) a parametric study relating shift in judgment with anchor remoteness without confounding by cumulative effects, (2) a comparison of intramodal anchor effects for visual and auditory series, and (3) control levels of intramodal anchor effects for evaluating the heteromodal anchor effects obtained in the fourth experiment. In the first phase of this study, visual durations were used. Seventy-five subjects were assigned at random to one of five conditions: no anchor, six-, ten-, fifteen-, or twenty-second anchor. Differences in mean judgments and in the slope of the

subjective scales were highly reliable. Thus, anchor influence is proportional to anchor remoteness but in a non-uniform manner. The judgment of the stimuli nearest the anchor (on the duration continuum) displays the greatest shift.

The second phase of the second experiment consisted of a replication of three conditions (no anchor, ten- and twenty-second anchor) of the earlier phase, but using auditory intervals. The results were essentially comparable, but the following modality differences were noted. In each condition, subjects who judged auditory durations used categories indicating greater duration than did those subjects who judged visual durations. In addition, all auditory subjective scales were best fit, by the method of least squares, by logarithmic equations, while all visual scales were best fit by power equations. Anchor effects were proportional for the two modalities.

As indicated above, the data of this experiment also served as the control levels for evaluating the effects of the heteromodal anchors used in the fourth experiment. In that study, four groups of fifteen subjects judged the standard series durations with the inclusion of either a ten- or a twenty-second anchor, which was either visual or auditory. In all cases, it was heteromodal with respect to the series modality. It was found that heteromodal anchors are effective, but that this is a function of both anchor remoteness and anchor modality. With the relatively small degree of anchor remoteness provided by the ten-second anchors, the shifts in the subjective scales with the heteromodal anchors were equivalent to those obtained with intramodal anchors. With the greater degree of anchor remoteness provided by the twenty-second anchors, heteromodal anchor effects were reduced compared to the corresponding intramodal effects, but with differential reduction for the two modalities.

In the third experiment, the modality differences obtained in the previous experiment were tested more rigorously. To obtain these data, twenty subjects judged a mixed series, which consisted of the standard durations, but half presented visually and half auditorily. Again, auditory durations were judged as longer than visual durations, and auditory subjective scales were more negatively accelerated.

The final experiment was designed to determine whether anchor stimuli, which were found to be effective in influencing the absolute judgment of duration, would also influence the judged difference in duration of auditory and visual stimuli. The magnitude of the modality difference found in Experiment III served as the control level. It was found that visual anchors increased the judged difference in duration for the two modalities, while auditory anchors decreased, or even reversed, the modality difference.

In the final section, the quantitative prediction of the point of subjective equality, or adaptation-level, was considered. It was found that equations of the type suggested by Johnson and by Helson (i.e., logarithmic, assuming a Fechnerian relation) were inadequate for the prediction of the data obtained in these studies. Starting with an alternative assumption regarding the psychophysical law, viz., Stevens' power law, a set of equations was formulated in which the predicted value of the adaptation-level is expressed as a "power mean" of the stimulus inputs. Excellent agreement was obtained between predicted and obtained values. The generality of these equations in the prediction of the adaptation-level for data from other perceptual dimensions was also demonstrated.

Microfilm $2.00; Xerox $6.60. 136 pages.

SEQUENCES OF BEHAVIOR IN SHOCK-ESCAPE TRAINING.

(L. C. Card No. Mic 59-3992)

Samuel Lewis Campbell, Ph.D.
Indiana University, 1959

As escape-from-shock training progresses, Ss increasingly hold the lever down. This is true both when shock termination is contingent upon a lever press (press training) and when it is contingent upon release following a press (release training). Not only is there substantial holding during shock-off intervals, but a substantial proportion of responses are punished (i.e., held until shock is reintroduced).

This study was an investigation of the effects on holding of two variables: training procedure (press vs. release) and intersession time. Also, an analysis of response properties was made in order to determine whether stimulus-response correlations inherent in escape training can account for holding.

Fifty-six albino rats were assigned to one of eight groups in a factorial design consisting of two types of training procedure (press vs. release) and four degrees of intersession time (0, 1, 5, or 10 days). Each S was given three 50-min. sessions of escape training. A 200 microampere shock and 20-sec. shock-off period were employed.

For purposes of analysis, responses were classified on two criteria: (a) whether the lever was pressed in the presence of shock (escape response) or the absence (extra response), and (b) whether the lever was released prior to the reintroduction of Shock (nonpunished) or after the reintroduction of shock (punished). Thus, four response-classes were generated: nonpunished extras, punished extras, nonpunished escapes, and punished escapes (the last cannot occur in release training). The changes and sequential relations of frequency, latency, and duration of each response-class were evaluated. The effects of holding-until-punished were investigated by comparing the properties of responses on trials following punished responses with those following nonpunishment.

1. Under both training procedures, the relative frequency of punished response-classes increases markedly.
2. There is a slight but significant increase in the mean duration of punished extras under both training procedures. The mean durations of all other response-classes are approximately constant.
3. Comparison on escape latencies indicates that they are longer following nonpunishment than following either punished response-class in either training procedure--possibly because the lever is "geographically" available for immediate manipulation if S is holding the lever when shock returns.
4. The proportion of escapes which are punished is greater following punished response-classes than following nonpunishment.

The above results favor the notion that holding is a

functional class of behavior which (a) shortens immediately subsequent shock duration and (b) is differentially strengthened when it occurs--possibly by the shorter delay of reinforcement-- (c) as indicated by the greater probability of holding on the subsequent trial.

In press training, the overall effect of intersession time on holding (relative frequency of punished escapes) is not significant. The pattern of effects is comparable to those commonly attributed to fatigue or other inhibitory factors which dissipate rapidly during rest.

In release training, the effect of intersession time on holding (relative frequency of punished extras) is predominantly decremental. That is, in release training, rests reduce holding. These results are comparable to those commonly attributed to the establishment of competing or interfering stimulus-response relations during rest.

A theoretical analysis of response chaining accounts for the interaction of training procedure and intersession time, and indicates, as do supporting data, that delays in training reduce the strength of extra presses (i.e., their initiation) and do not reduce holding per se.

Microfilm $2.00; Xerox $4.40. 81 pages.

WORD-ASSOCIATION STRENGTH AS A VARIABLE IN VERBAL PAIRED-ASSOCIATE LEARNING.

(L. C. Card No. Mic 59-3736)

Jean Effal Carlin, Ph.D.
University of Minnesota, 1959

Adviser: Kenneth MacCorquodale

To determine the effect of word association strength as a variable in verbal paired-associate learning word pairs "A" and "B" whose association strengths (A-->B) were known (from the revised Kent-Rosanoff norms) were selected and paired with nonsense terms "C"s in a variety of ways. In the first part of the experiment the "C" terms were the stimuli in an Original Learning List (OL) and the "A" words were the response words; then for an Interpolated Learning List (IL) the "C" terms again were the stimuli which were paired with "B" words such that the subjects learned OL: C--A; IL: C--B. In the second part of the experiment different subjects learned the "C" terms as responses to "A" words in the original learning list and to "B" words in the interpolated learning list such that the subjects learned OL: A--C; IL: B--C.

The A--B word pairs in the several lists used varied in degree of association strength both forward (A-->B) and backward (B-->A). Four levels or degrees of association strength were selected: High -- (A-->B)> 60%, (B-->A) > 42%; Moderate -- (A-->B) 28-59%, (B-->A) 19-47%; Low -- (A-->B) 12-27%, (B-->A) 6-19%; Zero -- (A-->B) 0%, (B-->A) 0%.

Because previous studies had demonstrated association strength to be an important variable facilitating interpolated learning and recall of original learning, this present study was designed to determine whether or not the degree of association strength influenced the degree of facilitation. Facilitation might be influenced by either or both forward or backward association strength relationships between "A" and "B" words.

The original learning lists and the interpolated learning lists were composed of paired associates learned by the anticipation method using a memory drum.

One might have predicted that the higher the degree of association strength between "A" and "B" pairs, the greater the facilitation of interpolated learning and original list recall. Actually, however, in both parts of the experiment (i.e., when the nonsense "C" terms were the stimuli for both original and interpolated learning lists and the "A" and "B" words were the responses and when the "A" and "B" words were the stimuli for the original and interpolated lists respectively and the nonsense "C" terms were the responses) learning of the interpolated lists which contained associated "A" and "B" pairs was facilitated significantly over learning interpolated lists with unassociated (0% association strength) A--B pairs. This was the case for recall of the original lists also.

Thus all conditions of association strength were clearly different from the zero condition but not clearly different from each other. Associations facilitate, but the evidence does not show that they facilitate differentially as an increasing function of association strength.

Microfilm $2.00; Xerox $4.60. 88 pages.

DISCRIMINATION LEARNING WITH SINGLE, COMPOUND, AND ALTERNATE STIMULUS SETS.

(L. C. Card No. Mic 59-4002)

Judith Parker Frankmann, Ph.D.
Indiana University, 1959

Each of 48 subjects learned four classical discrimination problems concurrently. Each problem used two discriminative stimuli, S_1 and S_2, where S_2 was the same combination of light plus sound in all four problems. The problems differed in the composition of the S_1 stimuli which were: (1) a light, (2) a sound, (3) either a light or a sound (Alternate problem), and (4) a light plus sound (Compound problem). For any one subject the S_1 lights and sounds were different from each other and from those of S_2. Two nonsense syllables, associated with S_1 and S_2, respectively, were assigned to each problem. Each problem ran 60 trials, half S_1 and half S_2. On the Alternate problem half the S_1 presentations were light and half were sound. Additional test trials used each training stimulus and also separate components of the compound stimuli.

Half of the subjects (Informed) were told the lights and sounds would help them choose the correct syllable. The remaining subjects (Uninformed) were not told about the stimuli.

Predictions of relative rates of learning on the four problems were derived from statistical learning theory. The Compound problem curve was predicted to lie between those for the Light and Sound problems, with the Alternate problem curve falling below these three. Curves for Informed subjects supported these predictions. Terminal correct responding for Uninformed subjects was considerably lower than for Informed subjects and problem differences were not clear.

Analysis of variance showed significant differences among problems and between instruction groups. An

unexpected result was the significantly inferior performance on trials presenting $\underline{S}_2$ compared with trials presenting $\underline{S}_1$.

Proportion of correct responding on test trials showed close correspondence, for the most part, to terminal level during training. Responding to components of compound stimuli was consistently inferior to responding to the compound itself. Microfilm $2.00; Xerox $3.60. 64 pages.

THE DEVELOPMENT OF A HUMAN RELATIONS INVENTORY FOR INDUSTRIAL SUPERVISORS BASED UPON WRITE-IN RESPONSES.

(L. C. Card No. Mic 59-4155)

Otto I. Kahn, Ph.D.
Purdue University, 1959

Major Professor: Dr. Joseph Tiffin

The supervisor's role in industry may be thought of within a cognitive-perceptual framework. In 1956 Fischl developed the Purdue Human Relations Inventory to differentiate between successful and unsuccessful supervisors on the basis of their expressed judgments regarding human relations situations. Although adequate validity was demonstrated for the final form, the variable of age accounted for most of the variance. The purpose of this project was to carry on the work begun by Fischl and redesign an Inventory based upon write-in responses.

Several investigations were carried out with the multiple choice format, including designation by the respondent of the BEST-WORST action to take in each case. None of these investigations resulted in a sufficient number of items necessary for the development of a predictive instrument.

The final phase of the study was devoted to the development of a Human Relations Inventory based on write-in responses. A new Inventory consisting of 25 items based upon twenty cases was designed in which the respondent was asked to write in a sentence or two what he "would do" and "what he would not do" in each case.

Original scoring categories were developed from a sample of ten completed Inventories subjected to a content analysis. An analysis of scorer agreement with a sample of 46 Inventories comprising the primary group, showed that scorers agreed with other scorers in their "slottings" in more than 65 per cent of the number of responses they were asked to slot.

An empirical scoring key was developed from the original scoring categories based upon the frequency with which a category was chosen irrespective of criterion separation. Twenty-nine supervisors from two corporations constituted a hold-out group. Two independent scorers agreed on an average of 22.2 items out of 25. A reliability coefficient of .81 was found when total number of correct items per Inventory was correlated for each scorer. Although the instrument could be scored with a high degree of scorer agreement, the Instrument failed to discriminate between criterion hold-out groups.

Because of the failure of the Inventory, when scored with the empirical key to discriminate, a new scoring key was designed which provided management with measurements on four variables. The number of responses slotted into the four variables or groups are totaled for each Inventory. To assist the scorer, a verbal-response scoring key was designed.

A final score was computed dependent upon the ratio of problem-solving responses and action responses to communicant responses. Forty-six supervisors from four corporations constituted the primary group. Each Inventory was scored using the new scoring system and formula. Of the 22 supervisors scoring in the high half of the test, 77 per cent were rated as superior, while of the 24 supervisors scoring in the low half, 46 per cent were rated as superior.

Two corporations constituted a hold-out group (N = 17, 23). In both corporations the test was found to possess an amount of validity to encourage use of the instrument as a predictive device to discriminate between supervisors rated as superior and those lacking in human relations. Two independent scorers agreed in 22 out of 25 items. A product moment correlation between total scores found by the two scorers was found to be .78 (.88 Spearman Brown Prophesy Formula), suggesting that the Human Relations Inventory, when scored with the aid of the verbal response scoring key can be scored with a high degree of scorer agreement.

Several revisions were made in both the Inventory and the scoring key to shorten the time of administration and to improve the task of the scorer. Several problems encountered in validating the instrument are emphasized to assist further research in the area of supervisory test construction. Microfilm $2.35; Xerox $8.20. 179 pages.

SPEECH ANXIETY (DRIVE) LEVEL, DEGREE OF RESPONSE COMPETITION, AND MODE OF RESPONSE IN A FORCED-CHOICE VARIATION OF PAIRED-ASSOCIATES LEARNING.

(L. C. Card No. Mic 59-4458)

David Simon Lepson, Ph.D.
University of Pittsburgh, 1959

This study was designed to test the hypothesis that speech (stuttering) anxiety could be expected to contribute to the level of generalized drive strength, $\underline{D}$, and, hence, that its manipulation in a verbal learning situation would affect performance in accordance with the principles of Hull-Spence learning theory. This hypothesis was derived from Wischner's proposal that speech anxiety possesses properties functionally similar to those attributed to other kinds of experimentally manipulated anxiety. The study was also conceptualized within the framework of Spence's theory of emotionally based drive.

The learning task employed was Ramond's forced-choice variation of paired-associates learning. The forced-choice feature of the paradigm permitted responses to be given either in the conventional oral manner or by the operation of a signaling device. Speech anxiety was manipulated by having one group of stutterers vocalize its responses and another group signal its response choices. This design was based on the assumption that speech anxiety would be evoked in stutterers in a speaking situation;

the rationale for the assumption was derived from empirical findings that autonomically mediated somatic changes precede and/or accompany stuttering behavior.

A group of normals (nonstutterers) was also tested under both response conditions to control for the possible effect on performance of variation in the mode of response, other than the effect expected as a consequence of the manipulation of speech anxiety.

Half of the correct responses had to be acquired under a condition of maximal response competition, and the other half under a condition of minimal response competition.

The subjects were 88 undergraduates, 44 stutterers, and 44 normals.

Analyses of variance yielded nonsignificant mode of response F's (i.e., the speaking normals and stutterers vs. the signaling normals and stutterers) for the competitional and noncompetitional aspects of the task. However, since the predictions concerning the relative performance of the speaking and signaling stutterers specified the direction of the expected differences, t's were calculated to obtain one-tailed tests of significance. The mean difference for the competitional aspect of the task, although in the predicted direction, was not significant ($p = .39$). The mean difference for the noncompetitional aspect of the task was also in the direction consistent with drive theory formulations, but also nonsignificant ($p = .17$).

The apparently greater sensitivity to variation in drive level of noncompetitional learning, as compared to competitional learning, which was suggested by the foregoing findings, was shown to be consistent with the results of previous drive theory research. An informal theoretical analysis provided a rationale for this difference in sensitivity.

The mode of response variable was shown not to have had a reliable effect on the performance of the normals.

The normals and the stutterers were shown not to have differed reliably in performance.

It was concluded that speech anxiety was probably not manipulated sufficiently for a valid test of the hypothesis. This conclusion was based on (a) an analysis of the method, which presumably lacked sufficient power mostly because of the probable occurrence of the stuttering adaptation effect; and (b) the positive results obtained by previous investigators in specifically related studies.

It was proposed as an overall conclusion that the present study did not make it possible either to accept or reject the hypothesis that performance in a verbal learning situation is a function of the level of speech anxiety.

Microfilm $2.00; Xerox $5.40. 108 pages.

A FACTOR-ANALYTIC STUDY OF PROBLEM-SOLVING ABILITIES.

(L. C. Card No. Mic 59-3524)

Philip Ralph Merrifield, Ph.D.
University of Southern California, 1959

Chairman: Professor Guilford

The intent of this study was to explore the possibility of explaining certain processes of problem solving in terms of factor dimensions.

A modified theory of problem solving was developed, based on five phases: preparation, analysis, production, verification, and reapplication. Because of the limitation on testing time and the necessity of spanning a large number of previously known factors, it was decided to test only six major hypotheses, all based on aspects of the production phase. For each of the hypotheses, alternatives were stated in terms of previously known factors.

Twelve new tests were developed as measures of the six newly hypothesized abilities. Three new tests were designed as criteria of problem-solving performance. In these three tests, the initial information was given and the goal specified; the examinee was required to indicate the solution.

The test battery was administered in late 1957 and early 1958 to 219 Naval Air Cadets and Aviation Officer Candidates at Pensacola Naval Air Station.

To increase the clarity of previously known reference factors, scores from alternate forms of certain tests with high factorial validity were included as separate variables in the factor analysis. A Group Indicator variable was included to measure the effects of differences between Naval Air Cadets and Aviation Officer Candidates. A Random Variable was included to estimate the appropriate standard error of factor loadings in this analysis.

Scores from 42 variables were intercorrelated and 14 centroid factors extracted. A total of 124 graphic orthogonal rotations were performed, using the criteria of simple structure and positive manifold. A third criterion, psychological interpretability, was imposed on the later rotations with regard to the reference factors, but not with regard to the new tests of the hypotheses or the criterion tests.

Ten rotated factors were identified as previously known dimensions: cognition of semantic units, cognition of semantic implications, divergent production of semantic units, evaluation of semantic implications, cognition of semantic relationships, divergent production of semantic relationships, cognition of semantic classes, convergent production of semantic relations, divergent production of semantic transformations, and cognition of semantic systems. One factor, tentatively identified as convergent production of semantic implications, had been suggested by other investigators, but no clear measures of it were available for this study. One factor, not previously identified, appeared as the first evidence for a factor predicted by the structure of intellect: convergent production of semantic classes. One factor was a specific generated by scores from alternate forms of the same test. The remaining factor was a residual, having no significant loadings.

The six hypothesized abilities were, for the most part, accounted for by previously known factors. The criterion tests had significant loadings on four factors, all previously known: cognition of semantic units, cognition of semantic implications, divergent production of semantic transformations, and evaluation of semantic implications. The two hypothesized abilities most related to the criterion tests were both concerned with working backward from the goal. It was inferred that the development of a search model played an important role in solving problems. There was no evidence of a unitary problem-solving ability.

An evaluation of the use of scores from alternate forms indicated that the procedure is usable, though not without risk of generating specific factors. The use of variables

like the Group Indicator appeared to be worth while for situations in which such questions arise. The loadings of the Random Variable indicated that the value of 0.30 as a lower bound for significant factor loadings in this analysis was justifiable. Microfilm $2.00; Xerox $4.80. 93 pages.

CEREBRAL ELECTRICAL ACTIVITY AND LEARNING.

(L. C. Card No. Mic 59-4316)

Victor Milstein, Ph.D.
University of Oregon, 1959

Adviser: Leona E. Tyler

A centrencephalic integrating system has been proposed by Penfield which functions in the recording of current perceptions, integration of the sensory and motor systems, and recollection of past experiences. Further, he has indicated that an epileptiform discharge originating in or propagating to this system would interfere with its functional integrity. Some reports in the literature have indicated that subjects manifesting diffuse epileptiform EEG discharges learn normally; other studies indicate variable degrees of impairment of learning ability. However, the exact relationship between such epileptiform discharges and the material to be learned has not been subject to rigorous investigation.

The following hypothesis emerging from these considerations was tested: in certain epileptics in whom flickered light stimulation evokes diffuse pathological activity on the EEG, learning will be impaired in the presence of such discharges but not when intermittent photic stimulation fails to elicit an abnormal response.

Two learning situations were employed with patients with convulsive disorders who manifested a reliable response to flickered light stimulation. The first consisted of learning several lists of paired adjectives of increasing difficulty under three conditions: during flickered light which elicited abnormal EEG discharges; during flickered light which did not evoke pathological EEG activity; and during a period where intermittent photic stimulation was not presented and the EEG was free from gross abnormality. The abnormal EEG responses fell into three major categories: Group A--spike-wave and multiple spikes; Group B--slow activity in the delta and theta range; Group C--mixed spike or sharp and slow potentials.

The second learning situation involved the formation of a conditioned avoidance response employing flickered light, which evoked pathological activity, as the conditioned stimulus. The conditioned avoidance response was learned to a criterion of five successive avoidances. Discrimination was then investigated employing as the differential stimulus another frequency of flickered light which elicited abnormal EEG activity similar to that evoked by the conditioned stimulus. Following this, the conditioned avoidance response was extinguished. The entire procedure was then repeated with flickered light conditioned and differential stimuli which did not evoke abnormal discharges. The order of presentation of these was reversed for one-half the subjects in each group. Instrumental motor responses, muscle potentials, and skin resistance changes were continuously monitored throughout the conditioning procedures as was the EEG activity. Analysis of the response measures indicated that they did not differ among the three groups when either normal or abnormal EEG activity was elicited by flickered light, during conditioning, discrimination, or extinction. Comparisons were also made of the GSR response, the number of trials to reach criterion, and number of successful avoidances for the three parts of the avoidance procedure.

The results indicated that the light-elicited abnormal EEG discharges did not interfere with the ability of the subjects to learn paired adjectives. However, the subjects manifesting abnormal slow activity learned more words than either of the other two groups regardless of whether abnormal activity was being light-elicited or not. No significant interference with the formation of a conditioned avoidance response, discrimination, and extinction occurred in relation to the light induced EEG changes. Conditioning of the GSR could not be demonstrated. Interpretation of these results should take into consideration the fact that the epileptiform and slow EEG activity manifested by the subjects was induced by intermittent photic stimulation. The evidence from this study indicates no significant disturbance in learning specific verbal and motor tasks during elicited epileptiform and slow EEG discharges.

Microfilm $2.00; Xerox $3.80. 67 pages.

A STUDY OF THE EFFECTS OF FILTERING UPON THE INTELLIGIBILITY OF WORDS VARYING IN FREQUENCY OF USAGE.

(L. C. Card No. Mic 59-4459)

Elmer Owens, Ph.D.
University of Pittsburgh, 1959

This study investigated the relationship between word familiarity and intelligibility. Seven word lists varying in familiarity, as defined in terms of frequency of usage on the Lorge count, were recorded under seven conditions of distortion achieved by low-pass filtering. The 210 college students serving as listeners were divided into seven groups of 30, each group listening under one condition of distortion. Test words were presented only once with no previous practice permitted. The seven lists were divided into groups of three, two, and two, each group of lists being matched phonetically and varied systematically with respect to word familiarity. The first group contained lists of low, moderate, and high familiarity, respectively. The first list of the second group was composed of low familiarity words and the second list comprised words of extremely high familiarity over a wide range of usage frequency. The two lists of the third group had much the same relationship as those of the second group except that one of the lists was composed entirely of contextual words: prepositions, articles, conjunctions, etc. The subjects wrote the words heard, and papers were scored on the basis of error responses induced by means of the high frequency filtering.

Basic conclusions were as follows:

(A) When monosyllabic word lists, phonetic content held constant, are presented to college students, lists

characterized by words of greater familiarity are significantly more intelligible.

(B) Concerning the PB-50 and W-22 intelligibility lists: (a) the markedly higher overall familiarity of the W-22's compared to the PB-50's should receive careful scrutiny in considering the greater ease of the former in terms of discrimination scores; (b) differences in overall familiarity among word lists within each of these two series, particularly among the PB-50's, would tend to cause variations in difficulty from list to list; (c) to the extent that the lists purport to measure hearing acuity for phonetic elements of speech, wide ranges in word familiarity on all lists of both series would tend to confound the scores.

(C) In any refinement of standard intelligibility lists, the factor of word familiarity should be controlled on the basis of an accepted word count. All words on a particular list should be from the same narrow frequency-of-usage band. Use of higher or lower frequency-of-usage bands would depend upon the level of difficulty desired.

(D) High reliability would be expected in a series of intelligibility lists in which test items are selected from the same frequency-of-usage band with the phonetic content held constant from list to list.

(E) Although familiarity of monosyllabic words plays an important role in their intelligibility, primary determinants of intelligibility remain the phonetic elements comprising the words.

(F) Contextual words should be omitted from intelligibility lists, since they do not behave in the same way as other parts of speech in terms of their frequency of usage-intelligibility relationships.

(G) Words having a usage frequency of over 2,000 should be omitted from test lists, as evidence indicates that the intelligibility-familiarity relationship is essentially asymptotic above this point.

(H) A person with hearing impairment might be expected to have disproportionately greater difficulty in discrimination as his loss involves frequencies under 1,560 cps, in terms of the filtering cut-off points of this study.

(I) Discrimination scores for persons whose hearing loss involves frequencies in the 780 to 1,560 cps range might vary widely depending upon differences in ability to take advantage of minimal phonetic clues in correctly "guessing" test items.

(J) An approach to aural rehabilitation centered around words of frequent occurrence in everyday usage is suggested. Microfilm $2.00; Xerox $5.60. 111 pages.

THE EFFECTS OF DRIVE LEVEL UPON PERFORMANCE IN A COMPETING-RESPONSE TASK.

(L. C. Card No. Mic 59-4380)

Marvin Schneider, Ph.D.
The University of Nebraska, 1959

Adviser: William Jarve Arnold

A basic inconsistency was recognized in the results of many studies investigating the relationship of drive level to competing-response learning performance. The issues were presented after introduction of a theoretical model for prediction of performance functions in such situations, and discussion of its unification of the apparently conflicting results of previous research.

The following hypothesis and corollary were derived from the model and tested empirically:

The relationship of drive level to performance efficiency in the learning task (as defined by trials and errors to a learning criterion) will be a non-monotonic function such that the "trials" and "errors" means of the ranked groups (lowest to highest drive levels) will indicate that performance efficiency decreases to a minimum at some intermediate drive level and then increases. Efficiency will be greater at the highest drive-levels used than at even the lowest drive-level.

As a corollary of the above, it was predicted that intrusions of associated adjectives would vary inversely with trials to criterion and directly with total errors. Thus the more efficient performance became, the fewer intrusions of previously associated responses there would be.

The experimental design employed nine groups of eight human subjects each. Electric shock was administered during training to induce a different drive level in each of the groups. For this purpose, a technique for scaling unpleasantness of shocks for each subject was used. During paired-associates task performance, experimental conditions differed for subjects only in the drive level variable. The 15 adjective pairs learned were taken from Haagen's list of adjectives of scaled associative connection. The task empirically duplicated characteristics and relationships developed in one specific example of application of the theoretical model.

The hypothesis and corollary were confirmed with a high level of confidence. The empirical data thus support the theoretical model from which the predictions were derived. A means was suggested for reconciling the conflicting results reported in the literature within the framework of the present theory. Further implications of the formulation and non-monotonic functions engendered were discussed. Microfilm $2.00; Xerox $3.60. 61 pages.

A QUANTITATIVE STUDY OF COLORED SHADOWS.

(L. C. Card No. Mic 59-4743)

Herschel Clayton Self, Ph.D.
The University of Texas, 1959

Supervisor: Professor Harry Helson

The binocular septum technique was employed in obtaining quantitative specifications of hue, lightness, and saturation of colored shadows. Since no review of the literature dealing with the binocular septum technique could be found, a chapter has been devoted to this topic and the conclusion was reached that the technique was both necessary and adequate for the problem under consideration. Fixed viewing apertures in the apparatus restricted the field of the right eye to an open Munsell Book of Color illuminated by a Macbeth Daylight Lamp and the left eye to a shadow which reflected only Macbeth daylight surrounded by a field of mixed chromatic and achromatic light. Achromatic illuminance varied over a range of 44.5 to 1 and chromatic illuminance varied independently over a range of 1,210 to 1. Highly saturated red, yellow, green, and blue sources were paired, one at a time, with the achromatic source to produce blue-green, blue, purple, and yellow shadows, respectively. Six observers matched the

color of the shadows by comparison with standard chips in the Munsell Book of Color.

When achromatic illuminance was held constant, the saturation of the shadow was a positive linear function of the logarithm of the chromatic illuminance on the surround. When chromatic illuminance was held constant, the saturation of the shadow was a negative linear function of the logarithm of the achromatic illuminance. Saturation of the colored shadow was approximately a positive linear function of the logarithm of the ratio of chromatic to achromatic illuminance. Thus, over the range of illuminances used in this study, it is the ratio of the achromatic to chromatic illuminance which largely determines the saturation of the colored shadow. The absolute illuminances, except when they are quite low, are of secondary importance.

With the red and green sources, the hue of the shadow varied with the achromatic illuminance, but this was not true of the yellow and blue sources. The hue of the shadow did not change with change in red, green, or blue illuminance in the surround, but it did change with change in yellow illuminance on the surround. The hues of the shadows differed from the mixture complementaries to the chromatic sources except in the case of the yellow source, where the hue was the mixture complementary.

Increased achromatic illuminance was accompanied by increased lightness of the shadow, while increased chromatic illuminance in the surround was accompanied by decreased lightness of the shadow as a result of contrast mechanisms. Lightness measurements were complicated by the fact that, except for the yellow source, all chromatic illuminances were less than one foot-candle.

The findings concerning the hue, lightness, and saturation of the shadows can all be accounted for in terms of the Alpha process (lateral adaptation) of Schouten and Ornstein (1939) who found that direct stimulation by chromatic light of any area of the retina is almost instantly followed by loss of sensitivity over the entire visual field to the components of this chromatic light. Thus an achromatic stimulus on one part of the retina tends toward the complementary of any chromatic source which stimulates the retina in other areas. Lateral adaptation appears to be at the basis of not only the colored shadow phenomenon, but color contrast in general. Colored shadows thus fall under the principle of color conversion formulated by Helson (1938) for the colors of papers viewed under strongly chromatic illuminants. Microfilm $3.05; Xerox $10.40. 235 pages.

THE EFFECT OF STIMULUS INTENSITY IN SENSORY PRECONDITIONING.

(L. C. Card No. Mic 59-4383)

Frank William Wokoun Jr., Ph.D.
The University of Nebraska, 1959

Adviser: William J. Arnold

This study investigated the effect of varying the intensity of one of the two preconditioning stimuli in the sensory preconditioning situation. Since one preconditioning stimulus preceded and partially overlapped the other temporally, there were two cases to evaluate: (a) intensity of the stimulus given first, designated the preconditioning CS; and (b) intensity of the stimulus given second, termed the preconditioning UCS. The stimuli were a buzzer, the intensity of which remained the same throughout the study, and one of three intensities of light (15-, 50-, or 100-watt bulb). The 140 rats used as subjects were assigned on a stratified-random basis to 14 experimental and control groups. The light and buzzer were presented to experimental groups 600 times in a forward conditioning sequence, while control animals received 600 presentations of one stimulus only, or no preconditioning at all. Two days later, an escape response was conditioned to a shock UCS, after which the preconditioning UCS (or a control stimulus) was paired with the shock in an avoidance learning situation. When avoidance training had reached criterion, the animals were given ten unreinforced test presentations of the preconditioning CS or a control stimulus. Finally, the preconditioning CS or control stimulus was paired with shock in a "transfer" avoidance learning situation. An animal's response on each trial was scored dichotomously as a CR or failure to give a CR. The dependent variables used as indices of sensory preconditioning were (a) CR's on test trials, and (b) rate of learning in the transfer learning situation. The results were as follows:

1. The 14 groups did not differ reliably on numbers of trials required to learn the escape response. Thus the groups were suitably matched for learning efficiency in this experimental situation.

2. Sensory preconditioning, measured by number of animals giving responses during the unreinforced test trials, was reliably demonstrated in five of the six experimental groups.

3. Within the range of intensities used, preconditioning CS intensity was inversely related to amount of sensory preconditioning, measured by number of animals giving test trial responses. A hypothesis derived from Hullian theory, however, had predicted a direct relationship, rather than an inverse one. An interpretation which resolves this discrepancy in the light of other information in the literature is suggested.

4. Preconditioning UCS intensity was curvilinearly related to amount of sensory preconditioning, measured by number of animals giving test trial responses. Hullian theory, however, predicts continued increases of sensory preconditioning with increases in intensity of preconditioning UCS. It is not known whether the observed (but statistically unreliable) decrement in the higher intensity range would have been verified if a larger sample had permitted more reliable estimation of the parameter value; hence the shape of the function cannot be established precisely. However, the observed significant increase in sensory preconditioning demonstrates that intensity of the preconditioning UCS is an effective variable in the sensory preconditioning situation and thus lends credibility to Spence's drive-reduction derivation of sensory preconditioning.

5. Data on mean number of test trial responses are consistent with the latter two conclusions, although the peculiar distribution of scores obtained precluded statistical treatment.

6. Mann-Whitney U-test comparisons of experimental groups with other experimental groups and with their respective control groups showed no reliable differences between the groups' criterion scores in transfer learning. The ten unreinforced test trials apparently extinguished the sensory preconditioning effect almost entirely, and unequal amounts of extinction probably rendered the transfer learning measures invalid as indices of sensory preconditioning. Microfilm $2.00; Xerox $3.00. 59 pages.

THE GOSPEL OF RIGHTEOUSNESS: A STUDY OF THE MEANING OF ṣdq AND ITS DERIVATES IN THE OLD TESTAMENT.

(L. C. Card No. Mic 59-4049)

Elizabeth Rice Achtemeier, Ph.D.
Columbia University, 1959

Chapter I: An Historical Review. Despite the importance of the concept, scholars have differed widely in their definitions of the basic meaning of ṣdq, holding it to denote (1) conformity to a norm; or (2) the fulfillment of the demands of a relationship; or (3) the wholeness of the soul.

Chapter II: The Linguistic Context and the Statement of the Thesis. Since etymology and the Septuagint are of little help in defining ṣdq, the "synonyms" and "antonyms" must be examined. Such examination reveals ṣdq to be a concept of relationship, expressing the fulfillment of the demands growing out of some relationship. It is often the "antonym" of עשׁק and the "synonym" of חסד and רחם, but it is not properly synonymous with the forensic שׁפט.

Chapter III: The "Righteousness" of Man Among Men. The ṣaddiq among men fulfills the demands of the communal relationships and thus upholds the community, being surrounded by peace, prosperity, and good. Ṣdq may be synonymous with "prosperity" or with "mercy" and "truth."

In the forensic context, ṣdq is again a concept of relationship, since the function of the Hebrew legal congregation was to uphold the communal relationships.

The Hebrew ruler, who could render legal judgments and hear appeals, was ṣaddiq when he upheld the rights of his subjects, thus guaranteeing the well-being of the community.

The basis of the well-being of the messianic kingdom will be the ṣdq of the Messiah, who will uphold and defend his realm.

Chapter IV: The "Righteousness" of Man before God. Faith is at all times the "righteousness" of man before God. Neither social "righteousness" nor obedience to the Law is complete without it.

The ṣdqh of the poor and afflicted is also faith.

Perhaps as early as the seventh century B.C., the poor and afflicted formed a special group of pious within Israel.

Ṣdq in the Book of Job is understood by Job and his friends to consist in the fulfillment of social demands. But the speeches of God reveal that ṣdq consists in faith which trusts all to the kindly provision of the Creator.

Ṣdq in connection with inanimate objects denotes the fulfillment of the demands of the relationship existing between those who use the objects.

Chapter V: The "Righteousness" of Yahweh. Yahweh is always ṣaddiq because He fulfills His covenant with Israel by saving her. Such salvation, as the manifestation of Yahweh's covenant Lordship, is received by Israel with joy.

Yahweh's ṣdq is always redemptive and is never identical with His judgment.

When Yahweh's kingship or judgeship is connected with His ṣdqh, it becomes redemptive in character, not only towards Israel but also towards all the earth.

Yahweh's ṣdq is intimately connected with every important theme in Deutero-Isaiah and with the central message of the book. Despite Israel's sin, Yahweh will act in ṣdqh to uphold His covenant with Israel by saving her. To this salvation, Israel, as Yahweh's witness and Servant, will testify, and such salvation will show that Yahweh alone is the true God. Thus, all will turn to Him to be saved. Through the action of His Servant, who is Israel, Yahweh will redeem all peoples. Man's sin is overcome, and Yahweh's ṣdqh is revealed in its saving fullness.

Microfilm $3.20; Xerox $11.00. 246 pages.

SOME RELATIONSHIPS BETWEEN ENVIRONMENTAL AND INSTITUTIONAL FACTORS AND OBSERVED DIFFERENCES IN CLASSROOM PRACTICES IN 36 PROTESTANT CHURCH SCHOOLS.

(L. C. Card No. Mic 59-4439)

Donald Addison Courtney, Ph.D.
University of Pittsburgh, 1959

The purpose of this study was to determine relationships that exist between environmental and institutional factors and classroom situations in Protestant Sunday church schools. An instrument used as the basis for objectively describing important characteristics of the learning situation in church school classes was developed. Trained observers used the instrument, the Church School Classroom Observational Rating Scale, in visits to classrooms to record observations on the eight selected dimensions. The eight dimensions, (a) Effort to Make Biblical Content Meaningful, (b) Number of Observable Sources of Classroom Instructional Content, (c) Extent to Which Subject Matter Is Related to Previous Knowledge, (d) Evidence of Pupil Attention, (e) Extent to Which Pupils Determine Learning Activities, (f) Effort to Provide for Individual Differences, (g) Extent of Provision for Constructive Pupil-Pupil Interaction, and (h) Number and Diversity of Classroom Activities, provide descriptive measures of classroom characteristics which reflect practical applications of important learning theories contained in religious education literature. The scores recorded by the observers for each five-minute period of class session represent descriptive categories along a continuum for each of the eight dimensions. A mean score for each dimension was then computed for each classroom involved in the study.

Observations were obtained in 108 classroom situations. The sample was selected so that a class in each of the three age divisions of the Sunday church school, Children, Youth, and Adult, in church schools representing three

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

different size groupings in each of four denominations located in a rural, urban, and suburban community, was observed. The use of the statistical technique, analysis of variance, permitted an analysis of the relationship of each of the four external factors to the characteristics of the classroom learning situation thus described.

This study also showed the value of the instrument as an aid to the observers as students of religious education. Each of the observers had particular training and experience in religious education. Their evaluations of the study, instrument, and the observation method reveal the value of the instrument as an aid to seeing more clearly what is taking place in the class session. It was the consensus of the observers that use of the instrument and method of observation would be an excellent teacher training practice, a valuable supervisory tool, and an aid to classroom evaluation.

A null hypothesis was tested for each of the four environmental and institutional factors on the eight dimensions of classroom practice. The analysis failed to reject the hypothesis that there are no significant differences among the Urban group of churches, the Rural group of churches, and the Suburban group of churches, except on Dimension D. The failure to reject this hypothesis indicates that quality of teaching is not dependent upon the cultural setting of the church school. The hypothesis that there are no significant differences among denominations located in the same type of community group could not be rejected on the basis of the data gathered for this study, except in Dimension E. This shows that the denominational factor is very limited in the extent to which it determines the classroom practices in the church school. The third specific hypothesis was rejected only on Dimension D. The failure to reject this hypothesis on the seven remaining dimensions means that the existing differences cannot be attributed to the grade level factor. The hypothesis that there are no significant differences among church schools of different size was not rejected on any dimension. This justifies for this particular sample the conclusion that the size of the church school does not significantly influence the quality of teaching. Microfilm $2.00; Xerox $6.20. 127 pages.

A STUDY OF CONTEMPORARY CHRISTIAN EXISTENTIAL THEOLOGY (KIERKEGAARD AND TILLICH) AND MODERN DYNAMIC PSYCHOLOGY (FREUD AND SULLIVAN) CONCERNING GUILT FEELINGS.

(L. C. Card No. Mic 59-3515)

Quintin R. DeYoung, Ph.D.
University of Southern California, 1959

Chairman: Professor Eitzen

Theology and psychology are unavoidably confronting each other with reference to guilt. This becomes most obvious in the practice of psychotherapy and pastoral counseling. This clinical attempt to "redeem" guilt brings into sharp focus numerous points of basic disagreement. The study seeks to clarify these differences.

Freud and Sullivan were selected as representative of modern dynamic psychology, and Kierkegaard and Tillich were chosen as representative of contemporary existential Christian theology. The writings of the four representatives were analyzed in an attempt to isolate significant differences with respect to five aspects of guilt: (1) genesis, (2) manifestations, (3) religious concomitants, (4) therapy, and (5) value.

It was hypothesized that not only similarities but also significant differences would be found to exist with respect to guilt. The hypothesis was supported at the five points noted above.

1. Genesis. The four men agree in relating guilt to anxiety. Guilt is a specialized form of anxiety. The psychologists, however, attribute the genesis of anxiety to the genetic dependency and helplessness of infancy, whereas the theologians stress man's ontological dependency, his estrangement and finitude. In the psychological account guilt is primarily a defensive reaction to threats of non-gratification and punishment necessitated by the demands of parents and society, whereas in the theological view anxiety and guilt are fundamentally ontic structures of existence and belong to man qua man. Guilt enters by the "qualitative leap," and existential (normal) guilt is to be distinguished sharply from pathological (neurotic) guilt. The psychological view ignores metaphysical aspects and considers the differences between normal and neurotic guilt to be quantitative only.

2. Manifestations. Psychology tends to see guilt mainly as pathological, whereas existential theology asserts that guilt is necessary to the achievement of authentic selfhood. While both disciplines acknowledge normal and neurotic forms of guilt, existentialism, in both its psychological and its theological expressions, contends that existential guilt differs qualitatively from neurotic guilt and does not lead to symptom formation. Freud and Sullivan recognize only a quantitative difference and imply that guilt is most frequently neurotic.

3. Religious concomitants. Both disciplines recognize that religion may be used neurotically. The issue at this point is, however, whether or not religion per se is viewed as being essentially neurotic. Freud's position on this issue is unequivocal and is unreconcilable with Christian views.

4. Therapy. At this point the sharpest disagreement exists because Christian theology claims to have the only ultimate solution to the problems of existential estrangement. In the Christian view, sin, anxiety, and guilt as existential "givens" are strictly objects of salvation. The theologians claim that the most refined medical techniques cannot heal the existential estrangements. It was suggested that this claim needs investigation and support.

5. The role and value of guilt. No direct data were obtained either to support or to refute the hypothesis, but it seemed justified to conclude that existential Christian theology values guilt as the presupposition of salvation, whereas psychoanalysis disvalues guilt because of its pathological potential.

Three supplementary hypotheses are discussed in terms of the further significance of the differences. It is contended that Christian existentialism provides a more comprehensive theoretical basis for psychology then positivism, and that the adoption of such a theoretical framework will result in increased therapeutic efficacy in dealing with guilt problems. Christian theology, on the other hand, should modify certain educational practices, indulge in less guilt-oriented preaching, and reconstitute its life of fellowship

in the light of what dynamic psychology teaches about the destructive potential in neurotic guilt. The future relations between psychology and theology will benefit most by frank recognition of the differences and continued research aimed at clarification. These are offered as heuristic suggestions.

Microfilm $4.25; Xerox $14.20. 329 pages.

AN EXPLORATORY STUDY OF THE CONCEPTS OF GOD REPORTED BY SELECTED SAMPLES OF PHYSICAL SCIENTISTS, BIOLOGISTS, PSYCHOLOGISTS, AND SOCIOLOGISTS.

(L. C. Card No. Mic 59-3526)

Meade David Riggs, Ph.D.
University of Southern California, 1959

Chairman: Professor Rhoades

The present work is derived from earlier investigations made by the late James Leuba, a psychologist, in which he asked selected groups of physical scientists, biologists, psychologists, and sociologists whether they believed in, did not believe in, or had no definite belief with respect to a stated concept of God, in this case a God to whom the scientist might pray in the expectation of receiving an answer. Leuba means for the word "answer" to include more than the natural, subjective, psychological effects of prayer.

With respect to the current study, questionnaires were sent to 707 appropriately selected scientists. Of those who received them, 297, or approximately 42 per cent, returned usable questionnaires. The obtained samples numbered 90 physical scientists, 70 biologists, 81 psychologists, and 56 sociologists.

The questionnaire is divided into four parts. The first part consists of items of identifying information, while the second asked the scientists to indicate the sources of their concepts of God, as well as the most important single source of those concepts. The third part of the questionnaire is composed of twenty-five carefully selected concepts of God, divided into three categories of religious philosophy, namely, naturalistic humanism, religious liberalism, and traditional orthodoxy. The scientists were asked to indicate those concepts which they felt were a part of their concepts of God by checking all twenty-five concepts either "yes," "no," or "no opinion." The fourth part of the questionnaire permitted the scientists, if they wished, to submit their own personal statements of their concepts of God.

Within the limitations of this study, it appears that the most important sources of scientists' concepts of God are parents, personal religious experience or practice, present or past scientific endeavor, and formal education. The concepts of God of psychologists are based on a smaller number of concepts, and these are more "nonreligious" than is true for the other three groups whose concepts are based on a larger number of sources which are more "religious" in character. There is a low positive correlation between the ages of physical scientists and psychologists and their responses to the religious liberalism scale of God concepts.

With reference to both the 25 categories used in this study and Leuba's study of 1933 involving a single concept, it would appear that the concepts of God held by physical scientists and biologists are more orthodox than those of psychologists and sociologists. The written statements of scientists which give their personal concepts of God show that sixty-three of the eighty-one statements submitted are of either a religious liberal or traditional orthodox character while eighteen of the eighty-one statements are of a naturalistic humanism concept of God.

Comments are made on the empirical findings of the study as seen in the light of the changing emphases of science which have taken place over the last thirty years, while the concluding summary statement points up the psychological and religious values of the present study.

Microfilm $3.80; Xerox $12.80. 295 pages.

SELF-OTHER DIFFERENTIATION AND ROLE PERFORMANCE: A STUDY OF PROFESSIONAL AGENTS OF SOCIAL CONTROL.

(L. C. Card No. Mic 59-4912)

Irwin William Goffman, Ph.D.
University of Michigan, 1959

The purpose of this study is to investigate the relationships between self-other differentiation, the extent to which an actor clearly distinguishes between himself and those with whom he interacts in a situation, and the performance of role requirements. Previous research suggested that a high degree of self-other differentiation would enable the actor to be invulnerable to the acts of others, control the expression of feelings of stress and be task-oriented. The thesis of this study is that these role skills are a function of both the role performed and self-other differentiation.

Two roles which specialize in social control and which vary in their requirements were selected. A therapeutic role in youth groups is oriented to re-adjusting deviants to acceptable moral and performance standards. A facilitative role minimizes deviance by supporting the currently acceptable socialization of group members. Therapists are more exposed to potentially stressful experiences than Facilitators and are less often permitted to communicate their experiences of stress or define others as the source of their experiences of discomfort. Both roles were assumed to require a task rather than a self orientation in role performance.

It was expected that self-other differentiation would be positively related to task orientation in role performance. The relationship between self-other differentiation and vulnerability to the acts of others was expected to be greater among Therapists than among Facilitators. The relationship between self-other differentiation and the communication of stress to others was expected to be greater among Therapists than among Facilitators.

From a national quota sample of adults working with groups of adolescent boys, 81 professional youth workers were selected who had been intensively interviewed and matched on a large number of factors. Production and special clinical coders used interview materials for measures of role, self-other differentiation and the dependent variables. The independent variables were found to be reliable and independent. Validity was established on the basis of relationships with factors theoretically expected to vary with each independent variable. The sub-sample was divided into the following categories for analysis (in approximately equal numbers): Therapists High and Low in self-other differentiation and Facilitators High and Low in self-other differentiation.

It was found that Highs were more task-oriented than Lows in the criteria they used for involvement with the boys, maintenance of appropriate role differentiation and problem focus. This relationship was stronger among Therapists than Facilitators, thus limiting the generality of the initial hypothesis. Self-other differentiation was inversely related to occurrences of experiences of stress and perceiving others as the source of such experiences to a greater extent among Therapists than among Facilitators; the second-order interaction was not fully demonstrated, however. Highs were less likely than Lows to express stress, particularly among Therapists, e.g., respond to deviance punitively or with intense anxiety. However, the expected second-order interaction was not fully demonstrated.

Microfilm $6.00; Xerox $20.80. 470 pages.

THE EFFECT OF MOTIVATION ON PROBABILITY PREFERENCES AND SUBJECTIVE PROBABILITY.

(L. C. Card No. Mic 59-4950)

Lawrence William Littig, Ph.D.
University of Michigan, 1959

This study examined experimentally the generality of certain theoretical relationships, proposed by Atkinson, between achievement-related motivation and preferences for different probabilities of winning in a game of chance. The theory states that: (a) individuals in whom the motive to achieve success is stronger than the motive to avoid failure will prefer intermediate probabilities of success; (b) individuals in whom the motive to avoid failure is stronger than the motive to achieve success, will least prefer intermediate probabilities of success, when performance is evaluated against some standard of excellence.

In light of earlier studies it was suspected that a stronger success motive biases subjective probability upward and a stronger failure-avoidance motive biases subjective probability downward.

A dice game was used as the experimental setting. Each subject experienced 96 rolls of the dice for each of five stated probabilities of success (.10, .30, .50, .70, .90). It was believed that repeated experiences with the dice would eliminate motivational biasing of subjective probabilities.

The specific hypotheses tested were:

I. Individuals in whom motive to achieve success is stronger than motive to avoid failure (a) will prefer stated probabilities of success that are somewhat lower than the stated probability of success of .50 in a game of chance before prolonged experience in the game; and (b) will prefer a stated probability of success of .50 following repeated experiences of winning and losing in a game of chance at each of a series of stated probabilities of success.

II. Individuals in whom motive to avoid failure is stronger than motive to achieve success: (a) will show maximum avoidance of stated probabilities of success that are somewhat greater than the stated probabilities of success of .50 in a game of chance; and (b) will show maximum avoidance of a stated probability of success of .50 following repeated experiences of winning and losing in a game of chance at each of a series of stated probabilities of success.

The success motive was measured by the McClelland adaptation of the thematic apperception test, the motive to avoid failure by the Mandler-Sarason Test Anxiety Questionnaire.

Hypothesis Ia was not supported. The subjects in whom motive to achieve success was assumed to be stronger preferred the highest probability of success. Hypothesis IIa received some support. The subjects in whom the motive to avoid failure was assumed to be stronger preferred the lowest probability of success. This result was taken to be consistent with the assumption of a downward biasing of subjective probability of success.

Hypotheses Ib and IIb were not supported: (a) the subjects in whom motive to achieve success is assumed to be stronger continued to prefer the highest probability of success; (b) the subjects in whom the motive to avoid failure was assumed to be stronger became indifferent to the five stated probabilities of success.

Result (b) above was taken to mean that the motive to avoid failure was not aroused during the latter stages of the experiment. Result (a) above was considered a new finding. It was interpreted to mean that in the absence of achievement-related rewards individuals who have a strong motive to achieve success tend to adopt a conservative strategy when the outcome of a situation is not a consequence of their own skills but is dependent upon chance probabilities.

It was pointed out that these findings have relevance to certain theories of economic decision which do not take into account individual differences in probability preference and subjective probability and that such social phenomena as insurance buying and gambling may be related to motivational variables.

Microfilm $2.30; Xerox $8.00. 175 pages.

A STUDY OF SMALL GROUPS IN BASIC TRAINING.

(L. C. Card No. Mic 59-4078)

Richard Maisel, Ph.D.
Columbia University, 1959

This was a study of the small groups which form among recruits during the first seven weeks of basic infantry training. The data was taken from a field experiment of recruit adjustment conducted by the Research Center for Human Relations (New York University) during the summer of 1952. The subjects consisted of 443 recruits who were interviewed in the first and seventh weeks of basic training and 92 recruits interviewed during the seventh week only.

The major findings of this paper were:

1. Friendship tends to form among recruits brought together by the formal organization of the army.
2. Cohesion in squads and platoons was not related to the conformity towards group norms.
3. Cohesion was not impeded by the heterogeneity of group members.
4. Performance in training and popularity were closely related to one another.
5. Instability of the status and role system did not impede the development of cohesion in the squad.
6. The self evaluation of the recruit in the seventh week of training was greatly influenced by his initial expectations during the first week of training, his actual status in the seventh week of training, and his perception of this status.

Microfilm $4.45; Xerox $15.00. 348 pages.

BUREAUCRATIC PROCESS, PERSONAL NEEDS, AND TURNOVER AMONG PSYCHIATRIC AIDES.

(L. C. Card No. Mic 59-4957)

Murray Melbin, Ph.D.
University of Michigan, 1959

Co-Chairmen: David Bordua
Morris Janowitz

This study was prompted by high turnover among psychiatric aides, a condition adverse to treatment goals as well as to the mental hospital's efficient operation. It was performed at two midwestern hospitals, using male psychiatric aides as subjects.

Turnover is cast into a theory of social dissociation with absenteeism taken as an early sign of the coming departure, and leaving a group assumed to be oppositely related to satisfactions derived from membership in it. The analysis combines insights from psychology and sociology to describe the personal needs of the psychiatric aide, the way his class position shapes them, how the hospital operation may provide or deny the means of satisfying those needs, and consequently the organization's relevance to the aide's tenure and turnover. The focus is mainly on the effects of a principle of bureaucratic organization--the interchangeability of its personnel.

Because unstable work assignments in the hospital prevent the development or continuance of informal social groups, and because these relationships are often gratifying, changes in scheduled work assignments are expected to foster absenteeism and turnover. It is further predicted that aides will be more likely to respond to changes in work assignments with absenteeism and turnover especially if the changes interfere (1) with their involvement in work outside the hospital, (2) with their friendships on and off the job, (3) to a lesser extent their need for power, but (4) not with their achievement needs--because of the aide's social structural condition.

A crucial methodological decision is the use of each absence as the reference point when examining relationships between changes and absences. The number of ward transfers, shift "rotations," and switches in days off falling several weeks before and several weeks after each absence were compared, and the resulting discrepancy score used to determine whether changes predominantly came before absences in time. Other data were gotten through interviews with aides, projective tests, and by asking nurses to fill out checklists about aides' behavior toward patients.

The findings supported the hypothesis that changes foster absenteeism. The predicted effect of involvement in other work on the change-followed-by-absence response was also supported. The expected positive influence of n-Affiliation was present but weak. N-Affiliation was the only variable significantly and positively related to absenteeism itself, suggesting the operation of other processes not studied here. N-Power showed the predicted positive effect only in interaction with the variable of involvement in other work. The lack of relationship between n-Achievement and the change-absence response appeared as expected, but there were some faint hints that the relationship might be negative when the situation is salient to achievement satisfactions for the aides.

The findings also supported the predictions that the more extreme change-followed-by-absence patterns would ultimately end in turnover. There was also tentative evidence that the intervening variables of involvement in other work, n-Affliliation, and n-Power operated more strongly in the change-absence responses of aides who left compared to those who stayed.

There was some tentative evidence that aides who left were more permissive toward patients, and that tenure was related to restrictiveness.

Microfilm $2.10; Xerox $7.40. 159 pages.

THE RANK AND FILE LEADER: A STUDY OF THE SOCIAL AND POLITICAL IDEOLOGY OF THE INDUSTRIAL UNION STEWARD.

(L. C. Card No. Mic 59-3214)

Sidney Morris Peck, Ph.D.
University of Wisconsin, 1959

Supervisor: Professor Hans H. Gerth

This dissertation describes the dominant social and political attitudes of industrial union stewards, with particular

emphasis on the degree to which these rank and file leaders are committed to a job, class or socialist level of consciousness.

Two basic research techniques were employed in the study. First, participant-observation was used to gain first-hand knowledge of factory "culture" and the shop steward role. Second, the "group discussion interview" was used, involving one-hundred and eighty-four industrial union stewards in the Milwaukee labor area in seventeen separate group sessions. A sound-recorded fictional report served to evoke unstructured, spontaneous discussion on a number of interrelated social themes. They are as follows:

a) The role of the steward in the shop and union.

b) The place of women and minority groups in industrial society.

c) Unemployment, recession and economic stability.

d) Nuclear war and international peace.

e) Juvenile delinquency and trade union corruption.

f) Success values and social opportunities.

g) Political action, the two-party system and the development of a Labor Party.

h) Socialized medicine and socialism as announced goal of organized labor.

As background for the interpretation of discussion material, this dissertation presents the historical development of the union steward role, the evolution of industry and organized labor in Milwaukee, and the current local political atmosphere. In addition, the effects of both the research setting and the group interaction process on the group discussions are examined.

One obvious result of this study is that industrial union stewards do not present a consistent, ideological assessment of social issues. And, the further removed the issue from the grievance situation, the greater the range of inconsistency in outlook. Thus, a steward may express job, class and socialist perspectives on a single issue. Despite the many contradictions in outlook, however, the social and political ideology of industrial union stewards appears to be informed by class-imagery.

In the most general sense, rank and file union leaders are class-conscious workers. While they evidence any number of status-concerns and ethnic traditions, stewards fundamentally express solidarity tendencies. Their image of society, its political and economic structure, is based upon the recognition of class divisions and differences. Hence, their identification with unionism denotes more than a job-conscious perspective; they feel a "consciousness of kind" with all workers.

This class-bound outlook of stewards does not take a socialist form. Stewards reject socialist solutions except in the limited area of medical and health care.

The study does not indicate the existence of sharp ideological differences between rank and file and top union leadership groups. Most union stewards tend to express official union ideology as their very own. This affinity of outlook is most clearly expressed in the hostile attitudes which stewards have toward rank and file members. Stewards perceive the problems of corruption and lack of political action as a function of rank and file apathy and indifference. Hence, solidarity sentiments, which unite the rank and file leader to the departmental worker on a personal, intimate level in the plant, seem to be weakened by status concerns arising from their union leadership position.

Stewards are very concerned about the rise of technological unemployment in the face of constant population growth. At the same time, nearly all stewards oppose weapons production as the alternative to recession. Hence, "automation" and "multilateral disarmament" loom as crucial economic issues for rank and file leaders of industrial workers.

While these revealed shop steward thoughtways may well be found in other industrial communities, this research should be viewed as a pilot study limited to Milwaukee area industrial unionists.

Microfilm $8.85; Xerox $30.00. 699 pages.

SOME FUNCTIONS OF THE NATIONALISTIC IDEOLOGIES OF MINORITY ETHNIC GROUPS.

(L. C. Card No. Mic 59-4986)

David Sirota, Ph.D.
University of Michigan, 1959

This is a study of the nationalistic ideologies of the American-born and the immigrant sectors of two American ethnic groups: the Irish and the Jews. These groups are used to test a general theory of the functions of immigrant and non-immigrant ideologies. It is hypothesized that the non-immigrant ideology serves to relieve the status-deprivation resulting from the inability of members of disvalued ethnic groups to affiliate with higher status reference groups. The ideology serves this function by providing a more acceptable image of the ethnic group for its members. According to the initial hypothesis of this study, the non-immigrant ideology stresses an ancient prestigeful condition of the group (Biblical Israel, medieval Ireland).

The immigrant nationalistic ideology, on the other hand, functions to relieve the deprivations resulting from the immigrants' participation in a set of new and largely unfamiliar role relationships. Features of the old cultural and social environment (especially economic role expectations) which once served to define the self-image now lose their applicability. Many individuals alleviate the resulting identity-deprivation by adhering to an ideology which preaches the necessity for separation from the new and unfamiliar and which stresses memories of the previous homeland, memories which serve to provide a stable social field in the midst of change.

The source of ideological materials is the editorials of important immigrant and non-immigrant newspapers. It is assumed that the content found in these editorials is representative of the total movement ideology. The research techniques used is content analysis; theme frequencies are the basic data. Ten hypotheses were tested:

Non-immigrant ideologies relative to immigrant will emphasize:

1. the revival of prestigeful characteristics from an ancient era;

2. the rejection of the present characteristics of the group;
3. the positive status attributes of the group;
4. the positive status attributes of the homeland;
5. a generally greater concern with status;
6. the similarities between the group and the surrounding society.

Immigrant ideologies relative to non-immigrant will emphasize:

7. the perpetuation of the group and its characteristics;
8. the cohesiveness of the group;
9. attachment to the homeland;
10. unfamiliarity with the American environment.

The results of the analysis provided substantial support for the predictions, but certain negative and statistically insignificant findings led to revisions of the original theory. These findings and revisions are as follows:

1. The Irish non-immigrants do not reject all of the characteristics of their group; they focus their hostility on those characteristics relating to religion. The prediction regarding the rejection of group characteristics was then modified to state that the status-deprived nationalist will reject only those traits which he perceives as negatively valued by the surrounding society.
2. The Irish immigrants tended to stress the revival of Ireland more than did the non-immigrants, and the differences in these categories between the two Jewish newspapers were relatively small. For this reason, the prediction regarding revivalism was revised. Revivalism is now considered to be only one answer to status-deprivation. The status-deprived nationalist may as easily identify with present sources of status, if any exist, such as present achievements of group members in this country or in the homeland.
3. Both the Jewish and Irish immigrants emphasize the perpetuation of only selected features of their culture; there is little evidence of a desire to perpetuate the total complex of old institutions. The hypothesis regarding perpetuativism was then modified to state that only those features of the group's former life which do not conflict with the necessities for participation in the new roles will be perpetuated.

Microfilm $3.30; Xerox $11.20. 254 pages.

SOCIOLOGY

SOCIOLOGY, GENERAL

RELIGION, SOCIAL STRUCTURE AND ECONOMIC DEVELOPMENT IN YI DYNASTY KOREA.

(L. C. Card No. Mic 59-3459)

Hesung Chun Koh, Ph.D.
Boston University Graduate School, 1959

Major Professor: Professor Albert Morris

The purpose of this dissertation is to investigate the key variables related to the economy of pre-modern Korean society. Similar studies have been made on China and Japan, but no comparable study has been made on Korea. Our hypothesis is that pre-modern Korea failed to develop the social and cultural bases for a modern industrial society largely because of its weak polity and its lack of favorable religious elements, and because of the formidable resistance to change of the Korean family and class system with their stress upon their own integration and solidarity.

On the assumption that the functional sub-systems of a society and its values are closely interrelated, especially with religion in Far Eastern societies, and that a change in the economic sub-system requires changes in the religious and other social sub-sytems, examination is first made of the social structure to locate the points of tension and strain and consequently the possible area where change could have started. The lack of material on Yi dynasty value systems and institutions compelled the writer to present first the value systems and the concrete structural units of the Yi dynasty society in detail by locating, translating, and organizing the materials in Korean, Japanese, and Chinese. These include legal codes, travelling diaries, anthologies, and religious ethical writings of the later Yi dynasty.

Because in Far Eastern societies religion and economy are closely related either directly or through polity, and because religion supplies the ultimate sanction for social behavior, stress is placed on the religious basis of Korean ethics. The religious basis is examined not only in terms of the interaction and inter-relationships of the concepts of the sacred, religious action, the priesthood, and the community of worship, but also in terms of its changes in relation to the economic ethics. Because an industrial society is above all characterized by strong economic values which facilitate the rationalization of the means, the tendency of the religious elements toward rationalization is emphasized.

The major findings are that the pre-modern Korean value system put more stress upon the integrative value as compared with the political or economic values than did Ch'ing dynasty China or Tokugawa Japan. This integrative value appears in the emphasis on the harmony and solidarity of the family rather than that of the state. Loyalty to the family head was stressed more than loyalty to the king, the head of the more extended collectivity. These

characteristics of the pre-modern value system are expressed in the concrete social structural units, in the elaborately developed honorific and kinship terms, and in the rigid stratification of roles according to sex, age, birth, and lineage.

The roles of women and sŏja (the sons of concubines of of the yangban class) were the points of tension. Women and sŏja were deprived of the means of attaining culturally prescribed goals in the Yi dynasty social structure. Women had no institutionalized channels of communication. However, more learned sŏja could belong to the chungin, professional class who served the king and ministers with their learning. The chungin had no political power and had lower prestige than the yangban, the class of government officials. It was the sŏja chungin together with some unsuccessful and dissatisfied politicians who promoted the Sirhak p'a, the Economic School of Confucianism.

The concept of the sacred characterized as "nature" or "inner essence of reality" in Korean religion was neutral in character and a less concrete reference for religious action than a personal God. There were two types of religious action toward the sacred. One was self-cultivation by unceasing study of the Confucian doctrines. The other was to return grace to the ancestor, a "sacred being." The former action was more stressed than the latter. The object of worship was determined by the nature of its "being" rather than by its action. Neither the concept of the sacred nor religious action could generate an economic ethics similar to those generated by salvation religions. There was neither a community of worship independent of the educational institutions, nor an institutionalized priesthood, which could help to set up the common goal of the society in a detached manner. The Sirhak p'a stressed political and economic ethics, but was little concerned with the redefinition of the concept of the sacred.

Korean religion reinforced the primacy of the integrative value through the yangban class. It reinforced the particularistic relations and the family, and emphasized less the universalistic relations or the state. Conversely religion failed to help the efforts of the chungin to emphasize political economic values. These are among the essential factors responsible for the failure of Yi dynasty Korea to develop the bases of a modern industrial society.

Microfilm $3.45; Xerox $11.80. 267 pages.

A STUDY OF ANOMIE AMONG LOWER CLASS NEGRO MIGRANTS.

(L. C. Card No. Mic 59-4953)

Albert James McQueen, Ph.D.
University of Michigan, 1959

This is a study of the adjustment of seventy-five Negro men, ages twenty to fifty, who migrated to an urban community (Ypsilanti, Michigan) during the years 1940 to 1957. The scheme of analysis was to relate several attitudes indicating successful and unsuccessful modes of adjustment to certain social structural conditions assumed to aid or hinder efforts to solve major adjustment problems. The organizing concept for the project was anomie.

A provisional typology of anomie was constructed. Objective anomie was defined as a condition of normative impairment in society involving weakened control of the behavior of all or a segment of the population, and subjective anomie as the impact of objective anomie on the individual that is expressed as a syndrome of alienation, anxiety, and purposelessness. From responses to questions in an hour interview, each respondent was ranked as high, medium, or low in each of the components of subjective anomie. The correlations among these rankings were not high enough to warrant the conclusion that a single subjective anomie syndrome exists as the tentative definition postulated. Therefore, the idea of subjective anomie was rejected, and the concept of anomie (not "objective" anomie) was retained to represent a condition of normative impairment and weakened social controls in society. Alienation, apprehension (the term used for mild anxiety), and purposelessness were conceptualized as important responses (though not exclusive or inevitable) to anomic situations. The presence of anomie was not demonstrated empirically, but its existence was assumed theoretically in terms of social and cultural disequilibrium in society which creates stresses for adjusting individuals.

Migrant adjustment was thought to hinge on the successful solving of two focal problems: (1) learning and relating oneself to the dominant institutional patterns of the new community, and (2) acquiring a satisfactory status-image. Despite the small sample, several hypotheses were formulated as guides. They covered three areas--background and personal attributes, the family, and occupation--and assumed that alienation, apprehension, and purposelessness would be high among migrants who experienced much difficulty in these areas as they tried to solve the two major problems.

The most alienated and apprehensive persons were generally unsettled and dissatisfied with their situation in the community. They were mostly twenty to thirty years old, veterans, late arrivals, non-voters, non-churchgoers, and persons knowing little about the community. They held the least positive attitudes toward the community. Status anxiety was suggested by the finding that these persons generally were high strivers who apparently assessed their opportunities for "getting ahead" as limited and thus had relatively low aspirations. None of the background characteristics such as size of hometown and farm experience yielded expected results.

The family variables--number of relatives in the community and size and composition of the family--were not related to the dependent variables. However, homeowners were less alienated, apprehensive, and lacking in purpose than renters, suggesting that owning a home is a visible symbol of stability and status and being a good family provider. The data mildly suggested that owning an automobile may serve some of the same functions.

The work-related variables did not produce a consistent pattern of results. Higher income respondents tended to be the least alienated, apprehensive, and purposeless, as did those persons who thought their jobs were worthwhile and important. Service workers were less apprehensive than unionized laborers about job security, but were more alienated, which suggests the absence of the camaraderie and common activities of unionized laborers. High sense of purpose was pronounced among persons with some occupational training, suggesting confidence and a sense of competence.

Microfilm $2.80; Xerox $9.60. 215 pages.

SOCIAL DETERMINANTS OF PHYSICIANS' REACTIONS TO INNOVATIONS IN MEDICAL PRACTICE.

(L. C. Card No. Mic 59-3208)

Herbert Menzel, Ph.D.
University of Wisconsin, 1959

Supervisor: Professor William H. Sewell

One hundred twenty-five physicians, constituting 85% of all general practitioners, pediatricians, and internists in active private practice in four cities, were interviewed intensively and the prescriptions they had written for selected drugs on sampling days over a 16-month period were recorded from pharmacists' files. Research previously published showed that the earliest users of a new drug were to be found predominantly among those most frequently named by their local colleagues as advisors, discussion partners, and friends.

This finding appears to contradict the familiar proposition that innovations are most readily accepted by "marginal men." In an effort to resolve this paradox, ideas were culled from experimental social psychology, anthropological theory, research in rural sociology, and decision analysis, and a hierarchy of hypotheses was constructed which could accommodate the new finding as well as propositions previously put forth by others. The hypotheses relate a doctor's integration among his local colleagues, his contacts with the medical profession in other cities, and certain other aspects of his position in the professional social structure to his responses to a variety of medical innovations. It is proposed that these relationships can be derived from assumptions about certain intervening mechanisms, termed "emancipation-conformity," "communication," and "assurance."

The resulting predictions were tested against data on innovating behavior and social position of the same 125 physicians who had given rise to the original finding. The recorded innovating behaviors included the use made of new drugs and the acceptance of certain modern principles of patient-management. The small number of cases and the relatively small differences between the associations that were actually observed make it necessary to treat all results as merely tentative. With this reservation, however, it may be said that most predictions based on the assumed mechanism of communication were confirmed; those based on emancipation-conformity were confirmed in part, with certain qualifications and questions left open; while those based on assurance found no confirmation.

It is concluded that the hypothetical scheme which had been formulated is a promising basis for further elaboration, but that considerable modification as well as specification in detail will be necessary.

Microfilm $3.75; Xerox $12.60. 289 pages.

THE SOCIO-ECONOMIC BASES OF THE POUJADE MOVEMENT.

(L. C. Card No. Mic 59-4659)

John Wallace Smith, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. W. Rex Crawford

With the winning of 52 seats in the French National Assembly elected in January 1956, the Poujade Movement became a significant political force. The present study is an attempt to identify the socio-economic and political sources of support for the Movement as revealed in these elections. The problem is attacked primarily through the comparison of 1956 election statistics with certain indices of socio-economic structure, and with the results of the 1951 elections. The broad generalizations suggested by interregional and interdepartmental comparisons are examined with greater precision in the more detailed study of several selected areas, especially the department of the Isère.

Regionally the Movement showed, in general, its greatest strength in areas that have failed to adapt to the conditions of modern economic life, particularly in those that have recently experienced relative or absolute decline in the face of competition from the more modern regions of the country, or have had to face depressed market conditions for an important local product. Areas of economic and population growth showed little inclination to Poujadism.

The anticipated importance of shopkeepers and artisans in the urban and small-town Poujadist electorate was confirmed. Industrial workers, with minor exceptions, were impervious to the Poujade appeal, as were the professional, technical, and managerial groups. The extent of peasant support for Poujadism varied sharply in keeping with the regional generalizations previously mentioned. With several significant exceptions, it tended to be highest in areas in which small, owner-operated farms predominate. In the diversity of the political antecedents of the Poujade electorate may be seen both the weakening of long-standing political loyalties in some parts of the country, and the continuity of a certain rightist tradition in others.

In conclusion, the broader political significance of the Movement is examined in the light of its post-election history. Microfilm $3.75; Xerox $12.60. 290 pages.

AN INTRODUCTION TO SOME SOCIO-CULTURAL FACTORS INFLUENCING THE ROLE OF THE UNITED STATES IN INTERNATIONAL NARCOTICS CONTROL, 1833-1920.

(L. C. Card No. Mic 59-4044)

Jack Bruce Thomas, Ph.D.
Indiana University, 1959

Activities of the Government of the United States in international narcotics control between 1833 and 1920 fall within three periods: one running from about 1833 until about 1879, during which the concern was with the trade in opium with Asiatic countries; a second running from about

1880 until around 1905, during which a concern with traffic in opium to the United States was added to the concern of the first period; and a third period encompassing roughly the years between 1906 and 1920, during which the concern with traffic in opium and other narcotics to the United States and its possessions became intensified, and during which the United States cooperated with numerous foreign powers in an attempt to control the traffic in narcotics.

Correlated with these three distinct periods of activity were varying socio-cultural phenomena. During the first period there was an economic necessity for trade with the Orient on the part of the United States because of the relatively undeveloped state of manufacturing in that newly emerged, independent State. At the same time, China and the Far Eastern countries in general were living in a relatively backward epoch of seclusiveness, which had little need or liking for trade, and who, consequently, operated in such a way as to make trade difficult for the capitalistic Americans and Europeans. The countries of the two areas reacted differently to these difficulties because of differences in political, economic, and military advancement.

Whereas the European countries were ready to fight over obstacles to trade, the Americans were not, even if it meant recognizing Chinese restrictions on the importation of opium.

During the second period in which importation of opium into the United States by the Chinese was put under control, the major socio-cultural factor operating was an ethnocentric attitude toward the Chinese who had been brought into the United States for work on the railroads and in the mines.

The third period of international narcotics control activity on the part of the Government of the United States began not only with the acquisition of the Philippine Islands, where there was a sizeable opium-smoking Chinese population, but with the improvements in printing of the last two decades of the nineteenth century which permitted the wide dissemination of the "opium myth" among Americans.

The "opium myth," a body of beliefs about the personal and social effects of the production or consumption of opium--beliefs later extended to opium derivatives and other drugs--probably originated in the Orient and was diffused to America by the missionaries to China, who found it a convenient rationalization for their failure to make wholesale conversions there. The myth also served as a rationalization for merchants who had failed to find anticipated markets in the Far East, and in the end provided the rationale for the International Opium Conference at The Hague in 1911, which in effect adopted the American conviction based on the opium myth, that the production of opium and other narcotics should be restricted to medicinal and scientific requirements.

Microfilm $7.10; Xerox $24.40. 559 pages.

SOCIOLOGY, FAMILY

FACTORS AND CHARACTERISTICS OF CATHOLIC MARRIAGE SEPARATIONS IN FIVE DIOCESES.

(L. C. Card No. Mic 59-3660)

Gordon James Irving, O.M.L., Ph.D.
University of Notre Dame, 1959

This research evaluates and extends the findings of previous research on Catholic marital problems as manifested in cases of canonical marriage separations. Previous studies were conducted in four eastern archdioceses and in the Archdiocese of Chicago. This project considers similar problems in five midwestern dioceses. In all the studies the data are derived primarily from the reports and testimony obtained in the separation process conducted by the chancery court. Thus, this analysis is limited to those problems that have been submitted to the ecclesiastical authority by presumably convinced Catholics. The reliability of such data may be considered relatively high since the separation process requires an honest attempt to delineate and assess the sources and manifestations of conflict.

The data obtained from these sources provides information regarding three areas pertinent to the marital problem: certain sociocultural factors, ethnic and religious backgrounds, occupational level; characteristics of the marriage itself, courtship, age at marriage, family size, and duration of the marriage; finally, the factors alleged by the parties to have precipitated or contributed to the maladjustment. It was noted that both ethnic and religious backgrounds were in many instances related to certain characteristics of the marriage and to specific types of difficulty experienced by the couples.

Occupational level was less clearly associated with the more important aspects of the marriage. One of the previous studies singled out ethnic and religious backgrounds as being influential factors. However, in this study notable differences in ethnic composition and type of marriage were also accompanied by differences in their relationship with other characteristics. This emphasizes the necessity of determining the presence and degree of influence of such factors in each area, and the necessity of caution in generalizing from data obtained in another area of study.

Other differences are indicated in the characteristics of the marital history. Findings from other studies indicated important differences in the factors of age at marriage, family size, and the duration of the marriages. Certain categories of age at marriage and family size were found to be associated with certain types of marriages and marital difficulties. The duration of these marriages indicated periods crucial for adjustment for different types of marriages and the periods in which certain problems tended to arise. However, the importance of these factors in themselves, as causing or contributing to maladjustment, is only inconclusively demonstrated in many instances.

The factors of disruption, precipitating and contributing, followed roughly the same patterns in all studies. Drink, adultery, temperamental clashes, and other manifestations of irresponsibility and immaturity, are the four principal categories of complaints alleged by the parties. Desertion, drink, non-support, and abuse are the chief concomitant factors. The combinations of precipitating factors and the

concomitant factors centered about each of these formed complexes that were found to be associated with certain types of marriages or characteristics of the individuals.

These studies do not conclusively demonstrate whether the factors of disruption and their accompanying relationships are the basic causal factors, or whether they are in some instances manifestations or symbolic of other more basic conflicts and difficulties. Of the preceding research projects, one seemed to imply that the causal influence of certain factors, notably drink, was demonstrated. The other study rejected this outlook, and the present research tends to agree with the latter conclusion. The solution of this fundamental problem will come about only through a different orientation in such research, and more valid and effective procedures in the analysis of marital maladjustment. Microfilm $4.05; Xerox $13.60. 313 pages.

THE FAMILY ROLE OF THE SCHIZOPHRENIC PATIENT PRIOR TO THE ONSET OF ILLNESS.

(L. C. Card No. Mic 59-4467)

Max Siporin, D.S.W.
University of Pittsburgh, 1959

This research examined the nature and content of the family roles of schizophrenic patients prior to the onset of their illness. Several related questions were also examined and these concerned: the characteristics of the family structure and their competence for adjustment to crisis; the nature and severity of the family problems and crisis situations to which the patients and families are exposed for a two-year period prior to the onset of illness; the effects of the family crisis situations on the patients, on their family roles and on their family groups. Several hypotheses related to these questions were also explored. A theoretical framework was formulated which viewed schizophrenic illness (on the part of family group members), as emerging from a family, small-group situation, as involving family role conflicts and a collective group disturbance, and as the outcome of a maladaptive process of family group and individual problem-solving, in reaction to chronic stress and crisis situations.

The research consisted of an exploratory-descriptive study of 14 schizophrenic patients and their families. The patients had not been hospitalized previously and were consecutively admitted to a psychiatric hospital ward. Fifty family members, including the 14 patients, were interviewed by the investigator in the dual role of psychiatric social worker and research worker. All of the study interviews were electrically recorded. The data were analyzed through case study methods and in comparative cross-tabulations.

Prior to the onset of illness, the patients were performing the following kinds of family role types: The Fussy Mother Hen, The Domestic Tyrant, The Hen-Pecked Husband, The Self-Sacrificing Mother, etc. Each of these family roles was found to be severely disturbed in conception and performance, and the subject of severe role conflict. Each of the patients had attempted to achieve new and more satisfying roles, but these efforts at change and at resolution of the role conflict were unsuccessful. In addition, each of the family groups was found to have been functioning at low levels of family competence for adjustment to crisis. Prior to the precipitating crisis, the patients and their families had experienced a large number of family problems, which had accumulated to become chronic stress situations. Each of the patients and their families then experienced stressful events, which precipitated acute and severe family and personal crisis situations. The data indicated that the definitions and the effects of these crisis situations were related to the role conflicts, and to the development of the schizophrenic illness.

The study emphasizes the importance of family roles and family role conflict, as well as "incompetent" family structure and functioning, and the occurrence of stressful events and family crisis situations, as pathogenic factors in the development of schizophrenic illness. It is suggested that the findings can be applied to individuals who are members of social systems other than the family. The findings support an approach which regards understanding and treatment of the family social system as a necessary way of helping mentally-ill patients who are family members. The study suggests implications for family diagnosis and family group therapy, for preventive family life education, and for community organization, aimed at furthering family competence, as well as individual social adjustment and mental health. The findings need to be subjected to specific research study, to be generalized through the use of more general subject groups and a control group design. The study points to the need for standardized measures, such as an Index of Family Competence, and diagnostic classifications, such as of family roles and family organizations, to enrich further social work research as well as social work practice.

Microfilm $3.55; Xerox $12.20. 276 pages.

SOCIOLOGY, PUBLIC WELFARE

LEGAL REGULATION OF THE SOCIAL WORK PROFESSION: WITH SPECIAL REFERENCE TO THE CALIFORNIA REGISTERED SOCIAL WORKER PROGRAM.

(L. C. Card No. Mic 59-4392)

Richard Russell Medhurst, D.S.W.
University of Southern California, 1959

Chairman: Professor Tufts

Legal regulation of social work has been a subject of increasing interest since the early decades of the twentieth century. The only substantial experience in the United States, however, has been in California, where a statutory program of voluntary registration was established in 1945 after a similar program had been operated under voluntary auspices for thirteen years.

This study is concerned with California's experience with legal regulation of social work as it provides data for the analysis of the concept of profession, the growth and development of social work as a profession, problems of regulating a profession, and the interest of social workers in legal regulation.

Forty social workers were interviewed to learn their opinions about the California Registered Social Worker program and their views of its strengths and weaknesses. The group interviewed was a 20 per cent sample of 201 respondents to a questionnaire who were identified with professional social work by education, membership in a professional association, and official registration.

Findings. (1) There was no consistent motivation for becoming a Registered Social Worker. (2) Belief in the principles of public protection became a primary motivation for maintaining registration. (3) The satisfactions received from being a Registered Social Worker generally were meager and limited. (4) Registrants as a group believed the program had achieved little that was positive. (5) Two "practical problems" pertinent to successful implementation of any legal regulation program were the shortage of personnel and the problem of the untrained or partially trained public assistance worker. (6) The group indicated marked adherence to legal regulation despite the limited achievements of the present program and the many problems in its administration. (7) Most registrants favoring regulation believed that compulsory licensing was the next step, despite the fact that the California program had not progressed in this direction.

Implications. (1) The limited achievement of the California registration program has been influenced by many registrants not understanding or accepting the purpose of legal regulation. Limited achievement seems due, in part, to de-emphasis on protection of the public, failure to delineate the professional worker and to distinguish him from others, and a lag in adapting registration standards to changing times and needs. (2) Shortage of personnel is a major problem that must be dealt with in order to effect a successful program of legal regulation. Public assistance presents a special problem because of the large number of untrained workers employed.

General guides for developing programs of legal regulation of social work, suggested by the study, are these: social workers must examine their motivations for wanting legal regulation; legal regulation must be approached broadly as a matter that encompasses social work service rather than the professional social worker only; a program of regulation should be established within a framework that includes nonlegal as well as legal methods of regulation; the social work profession must accept responsibility for providing leadership. Each state must determine for itself the most appropriate method of legal regulation, basing its decisions on such considerations as the stage of development of the profession, the ability and readiness of the profession to deal with the subject, the existing social and political climate including public readiness to enact regulatory legislation and public attitudes toward social work and social workers, and previous experience with regulation of professions generally. The program must be administratively sound and must be examined and evaluated continuously. Microfilm $3.45; Xerox $11.80. 267 pages.

SOCIOLOGY, RACE QUESTION

A NORMATIVE STUDY OF DESEGREGATION IN PUBLIC EDUCATION—A CRISIS OF MEANINGS IN CULTURE.

(L. C. Card No. Mic 59-4706)

Wilfred R. Smith, Ed.D.
Wayne State University, 1959

Adviser: August Kerber

The thesis of this study is that the goal of desegregation in our culture can be upheld scientifically. The various criticisms of this kind of a stand are examined, and we think refuted. The basic criticism that a normative approach to any study in the social sciences vitiates its scientific value is dealt with indirectly throughout, and directly in the beginning. The assertion is made that, in the vindication of an ideal for a culture, the statement of bias is necessary, and the full understanding and implementation of the goal requires the experiencing of the pertinent biases. The basic assumption is that the democratic ideology, with its self-correcting methods of social process and acceptance of rationalism, is the requisite matrix for determining the "musts" and "oughts" in a scientific manner.

The argument is developed in cultural terms that discrimination and treatment of individuals as members of a group—specifically any Negroes assigned to a condition of segregated disadvantagement—is inconsistent with main themes of our culture. Since these themes are in terms of meanings held by individuals in society, the conflicting individuals and groups who want to stave off desegregation in the public schools pose a crisis of meanings in culture.

The development of this crisis, the pertinent background data, both in the broadest range and in most specific events of recent legislation and decisions are mentioned. The strength of the Southern subcultural mores, the pattern of their beliefs, and the ingenuity of their methods in maintaining the white supremacy complex is described. The requisite attitudes and approaches on the part of the law-abiding community in relation to resistant Southern communities are expounded. The basic stand uttered is uncompromising on the moral issue, but a many-pronged, elastic attack in the realm of everyday affairs and specific cases, not to exclude the intelligent use of force in ultimate necessity is suggested.

The study proceeds as follows: Preface—a general rationale for the normative approach in this study. Chapter I—A general statement of the crisis caused by the May 17, 1954, Supreme Court decision on the "Five Cases," and a brief summary of the forthcoming treatment. Chapter II—The broad background of the desegregation problem is given. It is shown to be a legacy of the institution of slavery, which left mores and folkways enforcing a biracial caste-like system, and from which both groups suffer. Chapter III—The immediate background of legal decisions pertinent to desegregation are given. Chapter IV—The assumptions and limitations of the study are examined. Chapter V—The roles of public agencies and bodies, the local community, the courts, law enforcement, schools, mass media, and religion are described in an idealized way, to the extent that they are expected to function in upholding law and order. Chapter VI—The meaning of desegregation,

morally, legally, esthetically, and culturally, is shown. Chapter VII—The implication of desegregation in wider goals is outlined. Chapter VIII—A review of the actual situations of public resistance and legal subterfuge is made, with feasible approaches to containing them. Chapter IX—A study of six communities is given, showing the various processes involved. They are Sturgis, Kentucky; Mansfield, Texas; Beaumont, Texas; Clinton, Tennessee; St. Louis, Missouri; and Washington, D.C. Chapter X—The conclusions are given that we must be determined, prepared, and fully informed about the desegregating community. The thesis that the culture must be integrated with its common themes of equality and individuality is finalized. General programs are suggested to amplify desegregation and give the Negroes full social status in the American society.

Microfilm $3.60; Xerox $12.20. 279 pages.

SPEECH-THEATER

THE COMPROMISE OF 1850: A BURKEIAN ANALYSIS.

(L. C. Card No. Mic 59-4485)

Jack David Armold, Ph.D.
University of Illinois, 1959

This study is an application of Kenneth Burke's methodology to the Compromise of 1850. The act of compromise was viewed from the point of view of the rhetorical critic, and from the perspective of motivation generally, rather than from the perspective of the efforts of any one speaker. Five terms of Burke's "dramatistic pentad" were used as a generating principle for the investigation. Answers were provided to five questions which emerge from the terms: What was done (act)? When and where was it done (scene)? Who did it (agents)? How did they do it (agency)? and What was their object (purpose)?

Chapter one defined the act as compromise. Six individual bills, collectively called the Compromise of 1850 were enacted: California was granted statehood; New Mexico and Utah received territorial status; Texas' western boundary was settled; a more effectual fugitive slave law was authorized; and the slave-trade was abolished in the District of Columbia.

The act was analyzed in relation to the scene in chapter two to understand better the substance of the act. Extremism prevailed on the congressional, national, and territorial scenes in January, 1850. By March, a crisis was imminent. Convinced that conciliatory action was mandatory, the compromisers devised strategies to unite the estranged factions. Clay's resolutions became the locus of controversy. When the northern Democrats and southern Whigs identified with the compromise, the six bills passed in August and September.

The individual speakers who acted upon the scene were analyzed in chapter three. The agents of compromise were Clay, Webster, Douglas, and Foote; the counter-agents were Calhoun, Benton, Seward, and Jefferson Davis. The speakers' public characters were analyzed to determine their motivational power.

Endeavoring to answer the question of purpose, we investigated indirect concerns and proximate urgencies in chapter four. Previous compromises and political economic-moral causes indirectly affected the senators, but the actual crises in the territories and states directly and proximately guided the speakers' objectives.

In the fifth chapter on agency, the speakers' linguistic strategies were considered. The strategies had public content for they sought to strategically encompass the situation. They ranged from the bluntest quest of sectional advantage to a form that delights in appeal for itself alone, without ulterior purpose. We emerged from the analysis with the key strategy, "identification." Traditionally, "persuasion" is the term used to describe the rhetorical act. While Burke leans heavily upon tradition, he believes that identification is a more accurate term to use when describing what happens when speech is not wholly calculated persuasion, yet not wholly unconscious. Burke wishes to extend the sound traditional approach with his contemporary adaptation.

In the first chapter, the act was labeled "compromise"; in the agency chapter, we discovered that conciliatory language of the compromisers harmonized with the act. Similarly, the sectionalists' language corresponded with their partisan actions. Hence, language was the critical moment at which human motives converge.

The endowment of a unitary principle and design may make one parliamentary struggle superior to another. In the debate on the preservation of Union by compromise, the speakers employed numerous strategies (such as, imitation, courtship, and identification) to transcend the wrangling of competing voices. In the debate on the individual California bill, a unitary principle was absent and the strategies revealed divisiveness and estrangement. Debunking, materialization, and scapegoat strategies were characteristic of the debate. Thus, the Compromise of 1850 may be considered a superior parliamentary act because the transcending unitary principle of the preservation of the Union gave the struggle a superior design.

Microfilm $3.60; Xerox $12.20. 277 pages.

HISTORY OF BROADCASTING AT THE NATIONAL MUSIC CAMP INTERLOCHEN, MICHIGAN, 1928-1958.

(L. C. Card No. Mic 59-4879)

Henry Root Austin, Ed.D.
University of Michigan, 1959

The purpose of this study is to give an objective account of broadcasting at the National Music Camp during its thirty years, with enough background history of the camp

itself for proper appreciation of the part that broadcasting played in that history.

It is the further purpose of this study to show how broadcasting was a means by which the practice of teaching through performance was accomplished. This includes not only the teaching of music but, through television, of dramatics, interpretation, announcing, production of radio and television, and even dance and the plastic arts.

In the twenty-nine years since the first "Majestic Hour" network program from Interlochen, the National Music Camp has nearly run the gamut of broadcasting possibilities. Following the twelve years of network broadcasts, terminated by the union ban, the programs were carried by small commercial and non-commercial stations independent of the networks and of the American Federation of Musicians, and by the educational stations WKAR, East Lansing, and WUOM, Ann Arbor.

Station WKAR has carried twenty-four or more live broadcasts from the National Music Camp each summer for the last fifteen years. Beginning in 1949 many of these programs were sent on to Ann Arbor and transmitted simultaneously by Station WUOM. These live broadcasts, through the years, have given great numbers of students the inspiration of performing for a large audience, and the control and discipline which broadcasting demands.

Much of the significance of the history of broadcasting at the National Music Camp lies in its great scope. Beginning in 1930, only ten years after the first licensed stations in the United States began broadcasting, broadcasts from Interlochen became a part of the growth of network broadcasting in the United States.

The union ban on Interlochen network programs in 1942, and the subsequent blacklisting of the camp by the American Federation of Musicians are significant steps in the still-existing conflict between the educator and the professional in broadcasting. The history of broadcasting at the National Music Camp with its account of the Petrillo controversy gives an explanation of the educators' point of view as expressed by Dr. Maddy and the National Music Camp and of the union musicians' point of view as expressed by Mr. Petrillo and the American Federation of Musicians. It also gives the position of the governmental groups who are still trying to resolve the problems involved.

Broadcasting at Interlochen is an exemplification of how educational broadcasting has grown during the last fifteen years. Through the production and distribution of high-fidelity tapes, thousands of hours of Interlochen concerts have been broadcast over hundreds of local stations throughout the United States.

The educational impact, the cultural awakening, the practical results of responsibility and discipline which almost thirty years of broadcasting have had upon thousands of high school and university students can be estimated by the continual growth of the National Music Camp and the enthusiasm of those who have been a part of it.

Microfilm $2.75; Xerox $9.40. 210 pages.

AN EXPERIMENTAL INVESTIGATION OF THE INTELLIGIBILITY OF JAPANESE-BORN AMERICAN-SPEAKING MALE COLLEGE STUDENTS.

(L. C. Card No. Mic 59-3505)

Hal James Bargelt, Ph.D.
University of Southern California, 1959

Chairman: Professor Perkins

The problem investigated in this study was: Do characteristically Japanese vowel, consonant, and nonarticulatory speech errors equally affect the intelligibility of acquired American speech of Japanese-born male students? More specifically, the questions were: (1) Do the four types of vowel errors (substitution, omission, addition, and distortion) equally affect intelligibility? (2) Do the four types of consonant errors (substitution, omission, addition, and distortion) equally affect intelligibility? (3) Do the five types of nonarticulatory errors (faulty syllable stress, failure to obscure unstressed vowels or syllables, exaggeration, faulty pauses and rhythm, faulty pitch fluctuation) equally affect intelligibility? (4) Do characteristic Japanese vowel, consonant, and nonarticulatory errors when spoken by an Oriental voice and by an Occidental voice equally affect intelligibility? An assessment of the relative importance of vowel, consonant, and nonarticulatory errors upon the intelligibility of the American speech of Japanese-born male students was made by analyzing the mistakes of auditors who wrote what they heard when listening to a tape recording of sentences containing characteristic Japanese speech errors.

The experiment was developed in six main stages. First, fifteen standardized lists of twenty sentences each were selected. Second, fifteen Japanese male student-subjects from Los Angeles City College were recorded reading one of the lists of sentences. All had been in this country less than a year and spoke American sufficiently well to be accepted as college students. Third, the experimenter and two speech clinicians analyzed these recordings and selected the six sentences in which only one speech factor (vowel, consonant, or nonarticulatory) was in error. These six sentences were supplemented by twenty-four sentences recorded by the experimenter in which were incorporated typical Japanese speech errors. The same twenty-four sentences with identical Japanese errors were also recorded by an additional Japanese subject. These fifty-four sentences were randomized and put on Tape A for the listening session. Fourth, thirty-one male American-born students free from speech or hearing impairment were chosen as auditors. Fifth, Tape A was played and the auditors were asked to write down on an answer sheet as much of the sentences as they understood. Sixth, the answer sheets were analyzed and scored for intelligibility. The chi-square technique was used for statistical purposes.

Conclusions. (1) Characteristically Japanese vowel, consonant, and nonarticulatory speech errors do not equally affect the intelligibility of acquired American speech of Japanese-born male students. Vowel errors reduce intelligibility more than consonant errors, and both reduce intelligibility more than nonarticulatory errors. The relationship between these factors and intelligibility is highly significant beyond the 1 per cent level. (2) Vowel errors of omission appear to reduce intelligibility more than

vowel errors of substitution, addition, or distortion, as evidenced by differences among types of vowel errors significant beyond the 1 per cent level. (3) Consonant errors of omission reduce intelligibility more than consonant errors of substitution, addition, or distortion, as evidenced by differences among types of consonant errors significant beyond the 1 per cent level. (4) Nonarticulatory errors that affect several consecutive words in a sentence (faulty pauses and rhythm and faulty pitch fluctuation) tend to reduce intelligibility more than nonarticulatory errors which affect only a single word (faulty syllable stress, failure to obscure unstressed vowels or syllables, and exaggeration), as evidenced by differences among types of nonarticulatory errors significant beyond the 1 per cent level. (5) Sentences spoken by an Occidental are more intelligible to an Occidental audience than are the same sentences spoken with identical Japanese errors by an Oriental. Even though the degree of intelligibility varies between speakers with respect to vowel, consonant, nonarticulatory factors, the differences between the speakers for all factors is significant beyond the 1 per cent level.

Microfilm $2.25; Xerox $8.00. 172 pages.

THE OPERATION OF CONGRUITY IN THE ORAL COMMUNICATION SITUATION.

(L. C. Card No. Mic 59-4491)

Erwin Paul Bettinghaus, Jr., Ph.D.
University of Illinois, 1959

The purpose of this study was to investigate certain aspects of the cognitive organization of perceptual events occurring within the oral communication situation. The general hypothesis was that Listeners will tend to balance, or make congruous, their attitudes toward the elements of the oral communication situation. To shift toward congruity means to reduce differences or conflict among attitudes toward two or more stimuli within the same perceptual field.

The procedure involved an assessment and analysis of the pre- and post-speech attitudinal positions of experimental audience members toward the speaker, the speaker's delivery, the speech topic, and the treatment of the speech topic. Using three evaluative scales on a semantic differential as a criterion measure for listener attitude, the experimenter asked 232 undergraduates at Michigan State University to make evaluative judgments of six speakers and eight topics. Four speaker-topic pairs were then selected on the basis of low correlation between the speaker and topic scores. In a post-test session, each speaker delivered a series of speeches on the topic assigned to him, and post-speech measures of attitude toward the speaker, the speaker's delivery, the topic, and the speech treatment were obtained.

A factorial design provided for four replications of the basic experiment, allowing for a comparison of results from four different speakers and speech topics. The design also employed an "effective" and an "ineffective" mode of speech delivery for each speaker, and "strong" and "weak" treatment for each speech topic. Each speaker presented four speeches to four randomly selected audiences of subjects who had heard the speakers in the pretest sessions.

Results from this experiment indicated that a listener's shifts in attitude toward the elements of the oral communication situation were generally in the direction of creating a more congruous situation in keeping with the existing attitudes of the individual. The following conclusions were suggested:

1. The experimental subjects did tend to shift their attitudes toward the speaker and the topic to more congruous positions.
2. The shift toward congruity in the oral communication situation seemed to be determined more by the listener's attitude toward the speaker than by his attitude toward the topic.
3. The listener tended to balance the impression he received of the speaker's delivery with his impression of the speaker; for example, if the listener's initial attitude toward the speaker is favorable, and the listener perceives the speaker's delivery as unfavorable, then the listener's final attitude toward the speaker tended to be less favorable than his initial attitude.
4. Attitude toward the treatment of the speech topic is not shown as significant in determining the listener's attitude toward the speech topic. Differences between "strong" and "weak" treatment did not significantly affect the listener's final attitude toward the speech topic.

Microfilm $2.00; Xerox $5.80. 118 pages.

CONCEPTIONS OF DISPOSITIO IN ANCIENT RHETORIC.

(L. C. Card No. Mic 59-4893)

Elnora Madonna Drafahl Carrino, Ph.D.
University of Michigan, 1959

The purpose of this study was to present a detailed description of the use of the term dispositio as it was conceived and explained by the rhetoricians of Ancient Greece and Rome. An analysis was made of the treatises of nine Greek and Roman rhetoricians, from Corax in whose work the concept of dispositio first appeared about 446 B.C., to Quintilian who in A.D. 90 completed twelve books on rhetoric which included the most comprehensive historical materials on dispositio now known. Outlines were used throughout the study, to condense and clarify the explanations and rules for dispositio presented in the various rhetorics. English translations now readily available were used in footnote references to the Latin and Greek manuscripts.

On the basis of the analysis of the rhetorics and the historical or critical data relating to them, the general conclusion may be drawn that disposition should be the rhetorical term employed by students and teachers of rhetorical theory and practice to include the major components of selecting, arranging, apportioning, amplifying, and adapting proofs into a functional pattern of speech organization.

Several specific conclusions may be drawn from this study: (1) There was no single, distinct "classical" interpretation of dispositio among the earliest Greek and Roman writers. (2) There was little consistency in the development of the concept of disposito even within the rhetorical works by a single author. (3) There was little consistency among the rhetoricians studied, or within the writing of one rhetorician, in the labeling, ordering, content, or functioning

of "parts" as they related to dispositio. (4) There was no consistency among classical rhetoricians in the relative emphasis given dispositio, as compared to the other canons, (5) There was no single pre-Aristotelian conception of dispositio, since two of the earliest Roman rhetorics as well as two of the earliest Greek rhetorics were manuals of rigid, unvarying rules based on ready-made "partes-systems."

General tendencies may be noted, even among the varied discussions among classical rhetoricians: (1) Conceptions of dispositio varied most according to the kinds of speaking involved, the education of the persons for whom the treatises were conceived, or the purposes for which the plans of dispositio were introduced. (2) Dispositio is interpreted by at least one, and usually several, of the classical writers in terms of the "plan-of-the-whole" speech, a system of "arrangement," or a "partes-system" of from two to ten "parts." (3) Confusions developed as certain classical rhetoricians placed functions of dispositio under the canon of inventio. (4) In none of the rhetorics studied does the canon of dispositio receive the major emphasis. (5) Classical rhetoricians influenced future considerations of dispositio through their attacks on manuals that presented oversimplified "parte-systems" as the core of their teaching. Microfilm $2.75; Xerox $9.40. 210 pages.

THE EFFECT OF CLASSICAL RHETORIC UPON CHRISTIAN PREACHING DURING THE FIRST FIVE CENTURIES A.D.

(L. C. Card No. Mic 59-5098)

Father Benignus John Cloonan, T.O.R., Ph.D.
The Pennsylvania State University, 1959

Since the earliest century of the Christian era preachers have been criticized for the use of rhetorical devices in treating of divine matters. In the first Christian centuries, what was the attitude of the preachers themselves towards the use of these techniques? To what degree did they use these devices? This dissertation investigates both of these interrelated matters as they existed during the first five centuries of our era.

Preachers in the initial five centuries, as in all ages, were concerned over teaching the truth and persuading their followers to live by what was good and true, namely the doctrine and moral precepts of Christ. Were these ends to be best accomplished by a simple, unstudied, unadorned style of oratory, suitable chiefly to teaching, allowing the grace of God and the force of the truths uttered to persuade men's hearts? Or rather, was it to be carefully planned, using persuasive techniques of any kind, including ornamentation?

These questions had been debated by the pagan philosophers, for centuries before the advent of Jesus. The philosophers had been concerned over the effective communication of truth as derived from the pursuit of philosophy, hence, they had been fearful of sophistic argumentation and an undue playing upon the emotion which was sometimes brought about by the use of a highly theatrical style.

The Church, coming into being during the days of the absolute rule of the emperor, had to face in the speech of the day the very stylistic oratory of display. This type was commonly used then because persuasive, and even instructive, speaking might easily be considered subversive. The speech to entertain held the oratorical stage during the first centuries of the Christian era. The early Christians, realizing its inappropriateness in preaching were inclined to studiously avoid it.

The earliest followers of Jesus, St. Paul excepted, made little use of rhetoric in preaching. Paul saw the danger of display in preaching and opposed its use, although he was so familiar with rhetorical techniques that he used them copiously in his epistles.

The high-born converts to Christianity also were fully acquainted with rhetoric, which was the "core-curriculum" for educated Greeks and Romans. Those converts of this class who became clergymen were inclined to use the devices of rhetoric as something of a second nature. The aristocrats who made up their audience looked for such devices in the preacher's sermon.

The cessation of the persecution of the Christians on the part of the emeror in the fourth century gave considerable impetus to the oratory of display in the pulpit. The great preachers of the period, St. John Chrysostom, St. Gregory of Nazianzus, and others dreaded the danger of theatrics in the pulpit. Unhappily, lesser preachers succumbed to the demand for artificiality and theatrics in preaching. Such preaching led to a marked decline in the Eastern Church, though the Western branch, needful of converting the barbarian hoards spreading over their area, managed to avoid extremes in rhetorical artifice.

St. John Chrysostom and St. Augustine of Hippo formulated in writing the philosophy of using rhetoric in preaching. In De Sacerdotio John insisted that a priest be skilled in the use of rhetoric, but studiously unconcerned over the applause it might provoke in his sermons. St. Augustine of Hippo recommended in De Doctrina Christiana the use of rhetoric in preaching without any reservation, although he reminded the preacher of the need of praying in all phases of sacred discourse.

It may safely be concluded from this study that: (1) the Christian leaders were not condemning the use of rhetoric in preaching, but were warning against its excessive use, especially in regard to stylistic techniques, and (2) the Fathers, despite their own warnings, did use stylistic devices quite copiously, for the sake of being clear and forceful, however, not to be ornate.

Microfilm $4.50; Xerox $15.20. 351 pages.

THE RELATIONSHIP BETWEEN PERFORMANCES OF KINDERGARTEN CHILDREN ON A THREE-POSITION AND A DEEP TEST OF ARTICULATION.

(L. C. Card No. Mic 59-5103)

Hal A. Dorsey, Ph.D.
The Pennsylvania State University, 1959

The purpose of the study was to determine the relationship between performances of kindergarten children on two tests of articulation, for the [s], [r], and [l] sounds. One test presented each sound studied in the initial, medial, and final positions of certain test words. This test was referred to as a three-position test. The

other test presented each sound studied in a variety of phonetic contexts. This test was referred to as a deep test of articulation. The three-position test chosen was the Bryngelson-Glaspey Picture Tests for the [s], [r], and [l] sounds. The Deep Tests were constructed by the investigator so that each sound could be presented in 50 different phonetic contexts.

From the kindergarten children of the College Area Schools, Centre County, Pennsylvania, 180 children were selected as subjects. These subjects were selected on the basis of how they performed on the Picture Tests for the [s], [r], and [l] sounds. Fifteen children were selected for each of the following groups: Group A - those articulating correctly in all three positions; Group B - those misarticulating in one position; Group C - those misarticulating in two positions; and Group D - those misarticulating in all three positions. All subjects were given a Deep Test of Articulation for one of the sounds studied so that performances on the two tests could be compared.

On the basis of the data found in the study, the following results and conclusions were suggested concerning the articulation of [s], [r], and [l] by children on the kindergarten level:

1. There are significant differences in the mean number of correct responses obtained on a deep test of articulation among children who give different responses on a three-position test of articulation.

2. The magnitude of the correlation between performances on the two tests was not found to be sufficiently high to recommend the use of a three-position test where a measure of individual performance is needed.

3. Children who articulate correctly in all three positions on a three-position test show considerable inconsistency on a deep test, and therefore should not necessarily be regarded as having mastered a sound.

4. Children who misarticulate in all three positions on a three-position test show considerable inconsistency on a deep test and cannot therefore be regarded as being unable to produce the sound correctly.

5. Analysis of the overlap occurring on the Deep Tests when groups misarticulating in none, one, two, or three of the positions of the Picture Tests were compared one with another indicated that children giving these different performances on a three-position test show considerable overlap on a deep test and hence cannot be regarded as discrete groups of articulatory proficiency, and that the amount of overlap varies with the sound studied.

On the basis of the above findings, it was concluded that as a measure of individual articulatory performance, a three-position test is not an adequate procedure for use with children at an age before full mastery of speech sounds has been attained.

Microfilm $2.00; Xerox $7.00. 149 pages.

THE STRUCTURE OF O'NEILL'S SERIOUS DRAMA.

(L. C. Card No. Mic 59-3999)

James Frederick Elrod, Ph.D.
Indiana University, 1959

This study, The Structure of O'Neill's Serious Drama, deals with the various types of tragedy that the playwright attempted to create. As a basis for the later analyses of the separate plays, the examination begins with an attempt to establish the nature and requisites of a serious action. To produce an empathic concern for the protagonist and his fate, the playwright must depict him as a human being of some worth and show him in a threatening situation, thereby evoking a variety of fear and pity for him, his suffering, and his misfortunes. An action so presented will perforce result in meaningful statements about the nature of man and his universe.

The plays examined against this background are Ile, Beyond the Horizon, Diff'rent, All God's Chillun Got Wings, The Hairy Ape, Desire Under the Elms, The Great God Brown, Lazarus Laughed, Strange Interlude, Dynamo, Mourning Becomes Electra, The Iceman Cometh, and Long Day's Journey into Night.

In each play the component parts--plot, character, thought, language, music, and spectacle--are examined as a means for determining the particular kinds of fear and pity evoked and for discovering through such an examination the nature of the particular approach to tragedy. Special attention is given to the characterization of the protagonist and to the construction of the overall plot. The underlying dramatic concept, the representation of the action, and the artistic, emotional powers determine the impact and the significance of the drama.

The study points out certain similarities among characters and dramatic situations, presents the methods of dramatization utilized by the playwright, and constructs from the chosen dramas the sort of tragic world envisioned by O'Neill and the types of men and women who underwent catastrophic experiences within it. O'Neill advocated a kind of human creativity akin to the divine creation of the universe and of men. Hy sympathized with a poetic soul which could enable the human being to envision a better life. He admired the primitive vigor which allowed man to struggle towards developing any innate desire that could lift him above the commonplace. Opposing these two admirable human traits, O'Neill depicts the materialistic American business man and the religious doctrines that deny human sexual fulfillment. Because O'Neill dramatized a kind of world in which the romantic, imaginative man was doomed to failure and in which the primitive strength of brute man was deteriorating, his dramas echo an element of negativism which indicates that happiness can never be fully achieved; yet, O'Neill continually expressed admiration for the man who searched for joyful existence by attempting to understand himself and his relationship with the world and with a Higher Being.

Whether O'Neill was dealing in realistic or expressionistic dramas, he created an uneasiness about the general status of modern man and consequently a sympathetic pity. Because O'Neill believed that men and women could not achieve the Nietzschean exaltation he desired for them, the playwright composed dramas essentially of despair. Although he allowed Billy Brown in The Great God Brown

a certain sense of joy in discovering God through suffering, the dramatic idea generally presented by O'Neill was that man must suffer and that there is little hope for any great reconciliation with God and life. Therefore man resorts to such escapes as may be provided in dreams, drunkenness, and death.

Microfilm $6.80; Xerox $23.40. 534 pages.

THE PERSUASIVE TECHNIQUES OF CHARLES GRANDISON FINNEY AS A REVIVALIST AND SOCIAL REFORM SPEAKER 1820-1860.

(L. C. Card No. Mic 59-5105)

James Robert Emmel, Ph.D.
The Pennsylvania State University, 1959

The primary purpose of this study was designed to discover the rhetorically persuasive techniques used by Charles G. Finney as a revivalist and social reform speaker.

The biographical method and procedures were used, in which an attempt was made to reconstruct Finney's development as a speaker to discover the range, extent, and nature of his speaking; to examine the situations in which he spoke in terms of his audiences, subjects, and occasions; to determine the effects of that speaking; to formulate judgments on his methods and effectiveness from a devised set of criteria; and finally, to make an appraisal of the nature, worth, and influences of Finney's preaching.

That Charles G. Finney was persuasive as a revivalist and social reform speaker was made evident in this study through demonstration of the quantity of his speeches, the size of his audiences, and his success in winning converts and influencing the religious and reform atmosphere of his own time and far beyond his time. From this study certain fundamental conclusions and contributions emerge which give evidence that the persuasive techniques Finney used in his speaking were on the whole responsible for his effectiveness:

(1) This is the first specific study made of Finney's speaking--more particularly of his persuasiveness.

(2) This study compiles, systematizes, dates, and annotates for the first time the speeches, speech outlines, and geographical scope of Finney's itinerary.

(3) The study reveals that Finney's greatness emerged, not particularly because he lived at a time when America was ready for another religious awakening but because he developed his abilities and techniques to become a persuasive speaker.

(4) Finney's persuasiveness was due to his special attention to his lines of argument; he relied primarily on the amplification of his ideas through exposition for his logical proof; his emotional proof was at a minimum until he came to the conclusions of his sermons, and then he overwhelmed his audience with emotional proofs which were highly personalized applications of his arguments; and he did little to purposively establish ethical proof but relied primarily on his own reputation.

Finney used the topical order of arrangement. The arrangement was unique in the weight which he gave to the various divisions of the speech. The introduction was a brief statement of his speech plan. He then developed his arguments in the body of the speech. In a lengthy conclusion that comprised at least one-third of his speech he drew implications from his arguments which were very personalized to his audience in challenging them to make an immediate decision.

His style was one of his strongest persuasive techniques. It was clear, appropriate, and extremely forceful in spite of his grammatical incorrectness on occasions. His style was repetitious, and he avoided personal pronouns but used words which were all inclusive of his listeners. His use of figurative language, the use of loaded words, and artistic handling of language were means of deeply impressing his audience.

In matters of memory and delivery Finney was unique for his day. In his early preaching he made little direct written preparation but spent many hours in meditating, praying, studying the Bible, and studying his probable audiences; during this period he spoke without notes. As he advanced in speaking experience, he made specific preparation by always making an outline, although he did not always take the outline to the lectern with him. He deplored reading from manuscript and was one of the first ministers of the American pulpit to preach extempore. He spoke in a conversational manner and dramatized his ideas, using great variety in vocal qualities and gestures.

Another important persuasive technique Finney used was his keen analysis of his audience and the adaptation of his subject, his materials, and himself to his audience.

The study points out conclusively that Finney was effective because he understood speech techniques and knew how to apply them.

Microfilm $5.70; Xerox $19.80. 445 pages.

A DESCRIPTIVE STUDY OF THE INFLUENCE OF THE PHYSICAL ARRANGEMENT OF THE AUDIENCE UPON RESPONSE TO A SPEECH.

(L. C. Card No. Mic 59-4702)

Albert L. Furbay, Ph.D.
Wayne State University, 1959

Adviser: George V. Bohman

This study of the physical arrangement of the audience sought to describe the influences upon responses to a speech which are exerted by the spatial distribution of listeners. It was based upon a study of psychological mechanisms of collective behavior, rhetorical principles of public speaking, and controlled observations of listener responses in both scattered and compact seating arrangements.

Speakers have long been advised to utilize psychological characteristics of crowd relationships to facilitate the communicative process. These mechanisms - together with their homogeneous, emotional, and comparatively irrational responses - appear to operate more completely when the arrangement of the audience provides for a closer contact of persons involved in the communicative act. It is possible that the resulting influence upon the listeners' responses may come through either or both of two channels. The speaker may be stimulated to a more energetic

presentation which in turn heightens that response or there may be a direct listener-listener relationship by which members of an audience stimulate one another to a greater responsiveness.

Since these mechanisms of crowd behavior in the audience would seem to be stimulated by the proximate seating of listeners, this dimension of the problem was further studied experimentally. A recorded speech which urged the discontinuation of nuclear testing and utilized both logical and emotional appeals was presented to audiences of college students in both scattered and compact seating arrangements. Opinion changes were measured by a Woodward type shift-of-opinion scale, and the recall of factual material was measured by a multiple-choice test. The chi-square test and t test of differences were used to determine significant differences between the two experimental groups.

Compactness of arrangement made no measurable significant difference in how listeners liked the speech, how they thought they would like the speaker as a person, how much they felt they learned from the speech, how they estimated the effectiveness of the speech, the degree to which they indicated an awareness of how other listeners were responding to the speech, and how much they were able to recall. The one area in which significant differences did occur was in changes of opinion toward the proposition of the speech.

There was a significant difference at the 5% level of confidence in shifts of opinion between scattered and compact audiences, with the compact audiences showing the lower ratio of opinion change. Judged by this standard alone, the speech was less effective when presented to a compact audience. The compact audiences also tended to be more "hostile" before hearing the speech, in that their opinions were more nearly conformed to present national policy. This difference in initial attitudes (which was significant only at the 10% level) seemed to be influenced most by the initially hostile subjects in compact audiences, who showed the least inclination to register favorable shifts of opinion. Furthermore, women contributed more to the difference between experimental groups than did the men, though this difference was significant only at the 10% level.

A comparison of recall scores revealed a highly significant gain (at the 1% level) in factual information from hearing the speech over the scores of a control group who did not hear the speech and there was no significant difference between the experimental groups in this respect. If shifts of opinion were based upon intellectual responses to factual content, it may be that the heightening of crowd responses in the compact audience inhibited rational responses and developed a homogeneity of inaction. Whereas a person tends to be more emotional in a crowd, his critical, evaluative capacities are theoretically more acute when he is in comparative isolation.

Microfilm $2.40; Xerox $8.40. 182 pages.

A RHETORICAL ANALYSIS OF SELECTED CAMPAIGN SPEECHES OF G. MENNEN WILLIAMS WITH EMPHASIS ON THE 1956 CAMPAIGN.

(L. C. Card No. Mic 59-4925)

Murray Agar Hewgill, Ph.D.
University of Michigan, 1959

The purpose of this study has been to analyze the public speaking of G. Mennen Williams in his gubernatorial campaigns, 1948-1956. Specifically, the aims have been (1) to discover the nature of Williams' preparation for political campaigning, (2) to describe the historical environment of his campaigns, (3) to analyze his selection and treatment of campaign issues, (4) to discover the nature of his credibility as a speaker and the characteristics of his speaking skills, and (5) to discover the means of persuasion which he employed in selected speeches.

Williams' campaigns have occurred in a period of cultural changes which have provided clear-cut issues. It was a period of increases in population, urbanization, industrialization, and the power of labor unions. It was a period of increased governmental services to Michigan residents and of consequent higher taxation. The proposals which Williams made in his campaigns were intimately related to these economic and social conditions. He proposed actions to relieve the effects of seasonal layoffs and automation in industry. He advocated for Michigan residents such services as farm marketing programs, expanded educational facilities, construction of an arterial highway system, a Fair Employment Practices Law, and expansion of the state hospital system. To finance these services he proposed, in the period 1948-1956, increased corporation taxes rather than higher consumer taxes.

Williams has enhanced his credibility by his concern for the welfare of a wide variety of voting groups including, farmers, organized labor, Negroes, foreign nationals, and educators. Charges that he has been subservient to labor unions, injurious to business, and too often absent from the Capitol, have been used by opponents to weaken his credibility.

His greatest assets in speech delivery have been his physical appearance and his apparently sincere friendliness toward his audience. His bodily activity has been restrained, appropriate, and well-timed. His voice, although adequate in forcefulness and clarity, has possessed a slightly thin, nasal quality.

Williams' speeches follow most of the principles of good communicative usage. The organization usually follows a unified topical or problem-solution pattern. The reasoning in the speeches is based primarily upon three types of supporting material, statistics, specific instances, and quotations. Much of the content of the speeches is related to the desire for material comfort or relief of financial hardship. These appeals appear consistent with Williams' belief that all poverty and misfortune should be relieved. Ethical appeals are found in forty-five percent of the sentences in the eight speeches. The most frequently used methods of ethical appeals are (1) assertions that the speaker or his opponents possess certain qualities, and (2) references to events in which ethical choices were made.

The language in the speeches is characterized by concreteness, clarity, and interest value. By a content analysis

procedure it was determined that the average level of abstraction is in the fairly concrete range. Fifty-eight percent of the sentences in the speeches were categorized as reports, thirty-two percent as inferences, five percent as judgments, and the remainder was unclassified. Figures of speech, although used sparingly, provide clarity and interest value to the language.

Microfilm $4.75; Xerox $15.80. 370 pages.

A RHETORICAL STUDY OF SELECTED SPEECHES DELIVERED BY VICE-PRESIDENT RICHARD M. NIXON DURING THE CONVENTION AND PRESIDENTIAL CAMPAIGN OF 1956.

(L. C. Card No. Mic 59-4941)

Bernard Charles Kissel, Ph.D.
University of Michigan, 1959

The purpose of this study has been to analyze selected speeches presented by Vice-President Richard M. Nixon in the 1956 presidential campaign. In this connection, consideration was also given to such matters as the training and speaking experiences of Nixon, economic and political conditions during the year 1956, and the basic themes or issues recommended by the Republican National Committee and those advanced in San Francisco at the National Convention.

The economic and political conditions in the nation prior to the 1956 national election appeared to favor the Republican Party. The gross national product had increased to its highest level. The individual consumer, as reflected by average income, was making more money, and the business world as a whole was realizing greater profit. Politically, the apprehension concerning President Eisenhower's health, caused by his heart attack and ileitis operation, had been, for the most part, overcome by the time of the campaign. Another significant problem faced by the Republican Party at this time was the Harold Stassen objection to the candidacy of Richard Nixon. By the time of the Convention, however, this situation had changed, for Stassen himself seconded the nomination of Nixon.

Nixon's speaking activities in this campaign were extensive; he delivered 119 formal addresses and a number of informal addresses as he traveled approximately 38,000 miles. The major issues covered in these speeches were peace, prosperity, cost of living, and farm prices. The theme, however, which underscored the majority of Nixon's utterances centered around President Eisenhower and the Administration's record of accomplishments. A particular feature of Nixon's speaking in this campaign was the emergence of a so-called "new Nixon." The consensus of news comment was that Nixon was no longer the bombastic, attacking campaigner he had been in the previous campaigns. Reporters felt that he had become somewhat subdued and that his attacks on the opposition were more subtle than they had been previously.

From the rhetorical analysis of the selected speeches, certain conclusions were drawn: (1) Information, example, and comparison and contrast were the major forms of support found in the speeches. In this regard Nixon depended most heavily upon use of comparison and contrast in his speeches. (2) Emotional appeals were used extensively in the five speeches. The principal motive appeals found in these addresses were those to reputation, loyalty, duty, health and wealth, and opportunity and fair play. (3) Nixon established ethical appeal in the addresses principally by focusing attention on the probity of his character and by the establishment of good will with his audience. He focused attention on the probity of his character primarily by associating himself or his message with that which was virtuous or elevated. In most cases, this association was with Eisenhower. Nixon established good will with his audiences by adapting his message to each specific audience. Usually he accomplished this end by praising the audience or by identifying himself with the audience and their problems.

The study also considered Nixon's method of speech preparation and the editorial reactions toward him as a speaker in the 1956 campaign. This investigation shows that: (1) Richard Nixon personally prepared his presentations for the convention and campaign of 1956 based on data he secured from his staff and the Republican National Committee. (2) Nixon usually delivered his presentations extemporaneously. (3) Most observers concluded that Nixon was an effective campaign speaker in the 1956 presidential election year.

Microfilm $4.80; Xerox $16.00. 374 pages.

A STUDY OF SOME VARIABLES PERTAINING TO THE ABILITY OF CEREBRAL PALSIED CHILDREN TO UNDERSTAND SPEECH.

(L. C. Card No. Mic 59-4456)

Charles J. Klim, Ph.D.
University of Pittsburgh, 1959

This study investigated the relationships of some variables pertaining to the ability of cerebral palsied children to understand their own speech. Speech samples were tape recorded from 28 male cerebral palsied children from $6\frac{1}{2}$ to 16 years of age who had a wide range of articulation ability. These samples were later played back to the subjects who made understandability judgments by pointing to toy objects which represented the words in the speech samples. Articulation scores were obtained also by means of testing each consonant in each of three positions. Mental and chronological ages were obtained.

The results of this study indicate that the subjects understood normal speech significantly better than they understood their own speech. No significant correlation exists between the ability of subjects to understand themselves and their ability to understand normal speech. There is no significant correlation between the ability to articulate consonants and the ability of subjects to understand normal speech.

Subjects were not able to understand their own speech significantly better than the speech of other subjects. The ability of subjects to understand their own speech was significantly better than the ability of others to understand the speech of each subject. There is a correlation of .96 between the ability of subjects to understand their own speech and the ability of others to understand each subject.

A partial correlation between the ability of subjects to

understand the speech of others and mental age with chronological age held constant is .56. There is no significant correlation between chronological age and the ability of subjects to understand the speech of others with mental age held constant. Mental age and chronological age do not predict how well a subject is able to understand his own speech.

There is a correlation of .88 between the ability of subjects to articulate consonants correctly and their ability to understand their own speech. Articulation scores were the only measures in this study which indicated how well a subject might be able to understand his own speech.

Correlations between intelligibility scores on the subjects and various articulation measures indicate that shorter articulation measures predicted intelligibility as well as longer predictor measures. The simple count of sounds on the articulation test was found to be an adequate predictor of intelligibility.

Microfilm $2.00; Xerox $4.00. 71 pages.

ZOOLOGY

TYPES AND SOURCES OF PIGMENTS IN CERTAIN SPECIES OF LARVAL TREMATODES.

(L. C. Card No. Mic 59-4384)

Nadakal Mathai Antony, Ph.D.
University of Southern California, 1959

Chairman: Professor Martin

A review on pigments and pigmentation of parasitic organisms with special reference to helminths showed that haemoglobin and its derivatives occur more frequently than any other pigments, particularly in haematophagous nematodes and trematodes. Very little is known about carotenoids and melanins. Pigmentation is common in both adult and larval helminths.

Attempts have been made to study the chemical nature and sources of pigments in the larvae of the following: Euhaplorchis californiensis, Cloacitrema michiganensis, large pigmented echinostome, fin-tailed echinostome, small echinostome, Parorchis acanthus, Y-bladder cercaria, Catatrops johnstoni, Cercaria buchanani, and small xiphidiocercaria. Investigation of sources of pigments in these larvae necessitated the study of pigments of the snail host, Cerithidea californica, and of the four species of algae, Ulva sp., Enteromorpha clathrata, Chaetomorpha torta, and Hypnea johnstonii, some of which serve as food for the snail. Efforts have been made to correlate the host-parasite relationship of pigments by way of the food-chain cycle.

The first three algae contained chlorophyll a and b, β-carotene, and lutein; and the last one, chlorophyll a and d, β-carotene, lutein, phycoerythrin, and phycocyanin.

The snail host has been found to store β-carotene, lutein, carotenoid acids, zeaxanthin, and chlorophyll derivatives. Some of the lutein and one carotenoid acid were found esterified. The nature of the spectral curves and maxima indicated that the chlorophyll derivatives have the porphyrin ring still intact. No metabolic alteration has been noticed in the case of β-carotene. Occurrence and distribution of carotenoid and other pigments in invertebrates with special reference to gastropods, nutritional relationship of pigmentation, and biochemical value of pigments in the snail have been discussed.

β-carotene was extracted from nine species of larval trematodes. Only three species of rediae and none of the sporocysts contained chlorophyll derivatives. Besides β-carotene, "Y-bladder" sporocysts have been found to store an epiphasic carotenoid compound with single absorption maximum, which is a keto-carotenoid. Pigments extracted from four species of larvae during the months of June and July 1955 showed only one absorption maximum in the visible spectrum. Spectral and other properties indicate that these are carotenoids, probably keto-carotenoids or some pigments derived from β-carotene as isomerization products. Quantitative difference in pigment distribution has been noticed among four species of larvae. All evidence indicates that the larval trematodes absorb pigments from the snail host. They seem to absorb only the hydrocarbons from several kinds of carotenoids available in the snail. This preferential accumulation of β-carotene is rather unique among invertebrates, since they are known to store selectively xanthophyllic pigments. In this respect, the larval trematodes may be classified with certain species of annelids, echinoderms, and sponges which show predilection for hydrocarbons.

The parasitic larvae have been found to store the carotenoid and chlorophyll pigments in an unchanged condition. No esterification or oxygenation of pigments has been observed. However, in the large pigmented echinostome cercaria, β-carotene appeared to be conjugated with some protein.

Tests for flavones, riboflavins, haemoglobin, haematin, haemocyanin, bile pigments, and lipofuscines were negative in all the larval species.

Various histochemical tests have shown that the brownish pigments located in the eyespots and body tissues of three species of cercariae, large pigmented echinostome, Euhaplorchis, and schistosome, are melanins. Tyrosine, a precursor of melanin, has been found in variable quantities in all the nine species of cercariae studied. However, the results obtained for the presence of tyrosinase were inconclusive. The fate of eyespots in Euhaplorchis has been followed through the metacercarial stage recovered from the second intermediate host, Fundulus, over a period of six weeks.

Morphological aspects and biological significance of larval pigmentation have been discussed with reference to carotenoid, melanin, and chlorophyll pigments.

Microfilm $2.75; Xerox $9.60. 212 pages.

THE EFFECTS OF ALLOXAN DIABETES ON THE TESTIS AND RELATED SEX STRUCTURES IN THE RAT.

(L. C. Card No. Mic 59-3527)

Donald Wycoff Bailey, Ph.D.
Emory University, 1958

Recent reports that diabetes interferes with reproductive capacity in the human male and with sexual cycles in human females and in rats have prompted this investigation of the effects of alloxan diabetes on the onset of spermatogenesis and the functioning of related sexual phenomena.

Male rats 23 days of age were made diabetic with a subcutaneous inoculation of 250-350 mg/Kg body weight of alloxan in a 6% solution. Permanent diabetes was determined one week later on the basis of urine sugar content.

Diabetic rats were placed into 4 experimental groups depending on the subsequent treatment to which they were subjected. At one week after alloxan inoculation treatments of diabetic rats with insulin, chorionic gonadotrophin, and testosterone propionate were begun; some diabetic rats were untreated. Control rats were maintained. A group of non-diabetic rats was subjected to starvation to the degree that they maintained body weight about the same as diabetic rats.

At regular intervals following onset of treatment rats of all experimental groups were sacrificed for removal of testes, seminal vesicles, prostate gland, and pituitary gland for histological study. Testes were studied as to diameter, tubule diameter, progress of spermatogenesis, stage of the cell type in the germinal epithelium, and the activity of interstitial cells. Accessory glands were observed for secretory activity, and the appearance of vacuolated or otherwise abnormal cells was sought in the pituitary gland.

It was observed that diabetes took two forms. A severe diabetes resulted in failure of testicular descent with subsequent failure of the germinal epithelium, castrate type sex accessory structures, and generally poor health as a result of malnutrition. An intermediately severe diabetes caused delayed testicular descent with delayed appearance of sperm heads in the tubules, castrate type sex accessory structures, and malnutrition of a much lesser degree than that of the previously mentioned group.

Treatment with insulin corrected all the deleterious effects of diabetes on the reproductive system. Chorionic gonadotrophin did not cause testicular descent but did cause hypertrophy of the interstitial cells of the testis resulting in stimulation of sex accessory structures to secretory activity. Testosterone treatment also did not cause descent but did cause considerable stimulation of sex accessory structures. Rats maintained on inadequate diets showed delayed testis descent, delayed spermatogenesis, and unstimulated sex accessory structures.

Sex differences, in rats, to the diabetogenic action of alloxan and the differences in character of diabetes between the sexes are discussed. Male rats are more resistant to alloxan than are females, probably due to the fact that the male hormone, testosterone, has a definite systemic action, stimulating protein anabolism and causing subsequent decreased deposition of fat. The sex difference involved in incidence of diabetes resulting from subtotal pancreatectomy is the reverse of that observed with alloxan. It is suggested that androgens in the male may inactivate part of the alloxan administered before it can reach the pancreas, causing the amount of alloxan required to produce diabetes to be increased in the male.

These findings in the male diabetic rat when compared to the observations made on the effects of diabetes in the female rat indicate that there is some effect of diabetes in the effective amount of gonadotrophins reaching the testes. In addition, it seems that diabetes may cause an increased rate of destruction of testosterone in the liver. These suggestions combined with the effects of partial starvation are believed to be the causes of the observed lesions in the reproductive system of the male rat resulting from alloxan diabetes.

Microfilm $2.00; Xerox $4.80. 91 pages.

THE EFFECT OF FOREBRAIN ABLATION ON VISUAL DISCRIMINATION IN FISH.

(L. C. Card No. Mic 59-4886)

Jerald Jack Bernstein, Ph.D.
University of Michigan, 1959

The fact is well known that normal (non-operated) fish can make discriminations of brightness and hue. The object of the study here reported was to test whether midbrain (forebrain ablated) fish could make both of the aforementioned discriminations.

Cardiac deceleration, a conditioned autonomic response, was used as the measure of discrimination in a series of goldfish (Carassius auratus Linn.). Test animals had cardiac electrodes embedded bilaterally in the anterior portion of their visceral cavity so that, after suitable amplification, an electro-cardiogram (E.K.G.) could be recorded on an ink recorder. In order to hold an experimental animal rigid in the test apparatus, plastic skewers were placed through its back. Holders were placed over these skewers, and then the holders and fish were clamped to rails in a 50 gallon aquarium. A gray background was placed opposite the test animal's eye. All stimuli were standardized, color-aid art papers or art papers in combination with Wratten gelatin filters, 3/4 inch square, laminated in plastic and placed on the end of transparent plastic rods.

For any training series, a pair of stimuli was used. One of the stimuli was designated positive and the fish was shocked upon its presentation. The other was designated neutral and no shock was given upon its presentation. After each ten training trials the shocking apparatus was removed from the test animal and the neutral and positive stimuli were shown successively while an E.K.G. was recorded. After conditioning the test animal showed greater cardiac deceleration when presented the positive stimulus than when the neutral stimulus was presented.

In Phase I, midbrain animals were tested for hue discrimination. These animals were trained to a red and green patch of known hue and brightness. After learning to discriminate these training stimuli, the animals were tested on two red and two green stimuli of which one member was "darker than" and one member "lighter than" the gray background against which all stimuli were presented. Normal fish in this situation reacted to the test stimuli in terms of their wavelength characteristics but midbrain

fish consistently reacted to the brightness characteristics of the test stimuli. Other control tests in Phase I substantiated this finding.

In Phase II, midbrain and normal animals were trained to a brightness discrimination. Animals were trained to a pair of gray patches of which one member was lighter and one member was darker than the gray background. Normal animals could not make this brightness discrimination within 35 trials. Midbrain fish not only learned the brightness discrimination within 35 trials or less but generalized correctly when presented a different brightness problem.

Histology showed that in all but one of the operated brains the first normal cross-section fell at a level half way through the transverse commissure. The remaining brain showed more damage with the experimental lesion extending caudally to the very anterior border of the habenular nucleus.

The following conclusions regarding visual discrimination in midbrain (forebrain ablated) and normal (non-operated) animals were reached for the goldfish. Midbrain goldfish do not make a hue discrimination. Rather, they discriminate stimuli of different wavelength on the basis of such brightness differences as may be present. With autonomic conditioning, forebrain ablation resulted in more rapid learning of a brightness discrimination (as compared to normal fish) and did not result in loss of the ability of fish to generalize to a different brightness problem. Using electric shock as the unconditioned stimulus, the conditioned cardiac response was one of deceleration.

Microfilm $2.00; Xerox $4.40. 85 pages.

THE KILLDEER, CHARADRIUS V. VOCIFERUS LINNAEUS, IN THE BREEDING SEASON: ECOLOGY, BEHAVIOR, AND THE DEVELOPMENT OF HOMOIOTHERMISM.

(L. C. Card No. Mic 59-4891)

Munir Kiriacose Bunni, Sc.D.
University of Michigan, 1959

This study involved three major aspects: an ethogram of breeding Killdeers, including behavior patterns and ethological interpretation; ecology of nesting, especially the requirements for nest sites and choice of nest materials; and the behavior of young, their development, and thermoregulation. Thirty-nine nests with eggs, as well as numerous incomplete nests and many adults and young were studied in Michigan in the breeding seasons of 1955-1957.

Eleven types of vocalizations were described and their uses shown.

Eight courtship patterns have been identified. Several may occur consecutively, but most of them in no regular order. Scrape-display was the most conspicuous courtship pattern during nest-building and was often followed by copulation. The seasonal development of scraping and tossing ceremonies suggests they were the origin of nest-building.

Most nest sites were characterized by: open land; little or no vegetation (the average plant cover on 1 sq. m. around the nest in twenty-one sites was 11 per cent); elevation; the presence of nest materials; an object beside the nest; ground soft enough for digging; and shallow water nearby.

As part of courtship, males dug a succession of pits, in the last of which the eggs were laid. Materials were added to the pit to form typically a foundation of stones, a lining of plant chips, and a fringe of both materials.

Selection of nest materials depended mainly on size, shape, and color. Plant stems 5—20 mm. long and stones 5—10 mm. in diameter were most frequently used. Flatness and whiteness were selected qualities in stones.

The egg-laying period averaged 3.7 days, the interval increasing between successive eggs. Lost clutches were replaced a week later. Killdeers were determinate layers.

Males and females shared equally in incubation, exchanging at the nest, until late June, when the females started to desert, leaving their mates to care for the late brood. The ritual of change-over included tossing of stones and plant chips by the departing bird. The incubation period averaged 25.1 days, and hatching, 20 hr. Females were generally more solicitous and vociferous while present.

Young left the nest shortly after hatching and found their own food. Parental care of one first brood lasted 43 days, the parents driving them away when the second brood hatched. After flight began (30 days), "freezing" was still sometimes used in escape.

Although small young were homoiothermic at daytime air temperatures of 23°—40°C., experiments showed them to be poikilothermic at low temperatures (13°C.). At low field temperatures, thermoregulation was achieved through behavioral patterns of young and their parents. Improvement in temperature control followed a sigmoid curve, which began to flatten at 15 days. Even in warm conditions the temperature of small young was 4.5°C. below that of adults, which was attained at 27—34 days. Increase in body weight and emergence of juvenal feathers contributed importantly to the development of homoiothermism.

Fifteen patterns of agonistic behavior, in addition to displacement activities and simple calls of alarm and aggression, were identified as reactions toward other Killdeers. Each may be explained as resulting from pure escape drives, pure attack drives, or some combination of both. The behavior of Killdeers toward other animals, including man, was generally similar to, or derived from, the patterns performed in intraspecific encounters.

The behavior of Killdeers during injury-feigning showed strong evidence that it too can be explained as a conflict between escape and aggressive drives. These check each other and result in a mixture of locomotory intention-movements of both drives which constitutes the injury-feigning performance. Variations were caused by differences in the degree of conflict between these impulses. Injury-feigning was performed toward other intruders than man when this conflict was at a level high enough to induce it.

Microfilm $4.70; Xerox $15.80. 366 pages.

STUDIES ON SOME DIGENETIC TREMATODES OF PUGET SOUND, WASHINGTON.

(L. C. Card No. Mic 59-4372)

Hilda Lei Ching, Ph.D.
The University of Nebraska, 1959

Adviser: Harold W. Manter

Digenetic trematodes of marine fishes and shore birds were collected from the Puget Sound region in northwest Washington during the summers of 1957 and 1958. Studies were made on the life cycles of three species of larval hemiurids and two species of larval microphallids.

Twenty-four species of trematodes were identified from 21 species of fishes. Three of these species are considered new: Fellodistomum sp. (Fellodistomatidae) from Microstomus pacificus (Lockington), slime sole; Opechona sp. (Lepocreadiidae) from Sebastodes melanops (Girard), black rock fish; and Podocotyle sp. (Opecoelidae) from Leptocottus armatus, cabezon. Thirty-eight new host records, mainly for species of the Hemiuridae, are noted and the geographical distribution of trematodes of Puget Sound fishes is discussed.

Seven species of trematodes were collected from four species of shore birds. These species include one new genus and two new species of Microphallidae and one new species, Echinostephilla sp. (Philophthalmidae), all from the black oyster catcher, Haematopus bachmani Audubon.

Another new genus of Microphallidae was recovered from experimentally infected laboratory white mice after feedings of metacercarial cysts from the common mudflat crab, Hemigrapsus oregonensis (Dana). The natural definitive host is probably a shore bird.

The life cycle of Parvatrema borealis Stunkard and Uzmann, 1958 was followed from the sporocyst stage to metacercarial stage. Cercarial and metacercarial stages occur in different individuals of the same host species, Transennella tantilla Gould, a tiny viviparous clam.

The family Hemiuridae is briefly reviewed. Experiments and studies were conducted on three hemiurid cercariae. The embryology, excystment of cercariae, and metacercariae of Cercaria A Miller, 1925 are described. The cercarial cysts of Cercaria A were exposed to copepods, Tigriopus californicus (Baker) which became readily infected. Development of the metacercariae in the hemocoel of the copepods was followed up to 24 days. Cercaria B Miller, 1925 infected the same species of copepods and the metacercariae lived up to 16 days. Cercaria prenanti Arvy, 1949 is described from a new host, Dentalium dalli. Its cercarial cysts did not infect copepods exposed to them. Microfilm $2.00; Xerox $5.60. 112 pages.

THE BIOLOGY AND AFFINITIES OF THE TURTLE LUNG FLUKE HERONIMUS CHELYDRAE MACCALLUM, 1902.

(L. C. Card No. Mic 59-4132)

Richard Bradford Crandall, Ph.D.
Purdue University, 1959

Major Professor: R. M. Cable

The life history of Heronimus chelydrae has been completed experimentally and its various stages are described. The miracidium penetrates Physa integra and develops into a sporocyst with paired lateral branches. The embryos contained in the miracidium develop directly into cercariae in 20 days at summer temperatures; the usual intermediate larval generations are absent. The cercariae do not emerge from the snail and infection of the definitive host is acquired by ingestion of infected snails. Development of the cercarial body to the adult fluke in the turtle is described; approximately 90 days are required to reach maturity. Evidence is presented that gravid worms migrate from the lungs via the trachea and that the miracidia hatch in utero to emerge through the genital pore after the worms leave the host.

The taxonomic position of H. chelydrae is discussed in the light of information from the life history and larval stages. On that basis, it is concluded that the Heronimidae is a valid family belonging to the superfamily Paramphistomatoidea Stiles and Goldberger, 1910, as emended by La Rue, 1958.

Microfilm $2.00; Xerox $4.00. 72 pages.

BIODEMOGRAPHY OF RANGIA CUNEATA GRAY, 1831.

(L. C. Card No. Mic 59-4195)

Laurence Dee Fairbanks, Ph.D.
Tulane University, 1959

Chairman: George H. Penn

Rangia cuneata: a pelecypod mollusk commonly inhabiting brackish water coastal areas of the northern Gulf of Mexico, is known from Neocene fossiliferous deposits of the Mississippi embatment and is abundantly represented into the Recent epoch. References to this species in the literature are generally limited to mention only in ecological and geological surveys and species checklists. An investigation was made to determine pertinent physical and biological factors in the habitat of R. cuneata concerning population density, sizes of individuals and the reproductive cycle. Two areas, approximately ten miles apart in Lake Pontchartrain, Louisiana were selected for the investigation carried out from February, 1957 to September, 1958. Temperature, salinity, total phosphorus, phytoplankton pigment concentration and oxidizable organic matter in solution were measured and/or estimated. Population densities by size classes of adult clams and juveniles greater than 0.375 mm in length were estimated for the two areas from quantitative bottom samples collected throughout the period. Non-quantitative samples of adults

were collected routinely for gonadal analysis to elucidate the reproductive cycle and estimate the extent of gonadal parasitism. Growth rates of clams under three years of age were estimated from analysis of the quantitative bottom samples and lines of growth interruption in the shells of adults.

Temperature varied between 47° and 90° F; salinity, between 0.5 and 5.77 o/oo while total phosphorus ranged between 0.0035 and 0.0113 μg at/ml, values considerably higher than average for seawater indicating potentially high productivity. Total phosphorus varied directly with salinity (lowest in the summer of 1958) during the period. Phytoplankton pigment values were highly variable with the highest values representing the early summer of 1958. Estimates of oxidizable organic matter in solution were higher in the early summers of both 1957 and 1958, with the highest estimates representing the summer of 1958. The environments of the two study areas differed chiefly in textural type and concentration of organic matter in the bottom deposits and organic matter in solution.

Greater density (2.88 per sq. ft.) of adults occurred in the area having higher concentrations of organic matter. Mean size of adults and growth rate of clams under three years of age were less in the latter area while shell weight for comparable sizes was smaller in the 90 percent of adults. Sex was more frequently distinguishable and the gonadal tissue firmer and more distinctly colored among clams of the area having a bottom type of sand with less organic matter.

Density of juvenile clams was not significantly different in the two areas.

Spawning of Rangia may occur at any time but is more extensive in late spring and early summer and least during mid-summer. Microfilm $2.00; Xerox $6.60. 137 pages.

THE NATURAL HISTORY OF DORYLAIMUS STAGNALIS (NEMATODA).

(L. C. Card No. Mic 59-4906)

William Edward Fennel, III, Ph.D.
University of Michigan, 1959

The purpose of this study was to investigate the life history, distribution, and ecology of Dorylaimus stagnalis, a free-living, aquatic nematode, in Douglas Lake, Michigan.

Collections of benthic sediments were taken with either an Ekman dredge, or with glass tubes while using a self-contained underwater breathing apparatus (SCUBA). The worms were separated from the sediments either manually or by a modification of the Baermann funnel technique. SCUBA was also used to examine the benthic habitat of the nematode in several different areas of the lake.

The life history consists of: gametes; embryonic stages; first-, second-, third-, and fourth-stage larvae; adults of both sexes. First-stage larvae hatch from eggs three to six days after oviposition, depending on temperature. Growth and the subsequent molting of the cuticle on three occasions resulted in three progressively larger larval stages. The fourth molt produces the adult in which reproductive organs are fully developed. Although the worm was not cultured for its complete life cycle, it is believed that more than six months are required for the completion of the process. Molting appears to occur only in the absence of light. The sex ratio of Dorylaimus stagnalis in Douglas Lake was 52.48 in favor of females, although the ratio is not uniform throughout the lake. Gravid females occurred in approximately the same frequency in the sediments during the entire year. The maximum number of eggs oviposited in laboratory cultures was 45.

The more dense populations of the nematode are found in soft black ooze, although they occur more uniformly in sandy mud. Their distribution within each of the eight depressions of the lake appears to be related to the type of sediment and the particular location in the lake. The most densely populated area contained 7688 dorylaims per square meter. They are most frequently found in a zone between depths of 9 and 14 meters. Within the sediments, the worms inhabit a zone extending from the surface to a depth of five centimeters, although most of them occur in the upper three centimeters. Aggregates of the sediment, here called "mud balls," represent a micro-concentration zone of this species within soft black ooze and sandy mud.

The benthic organisms living in the same habitat as Dorylaimus stagnalis included Ciliata, Flagellata, Porifera, Hydrozoa, Turbellaria, Nematoda, Rotifera, Gastrotricha, Polyzoa, Oligochaeta, Unionidae, Sphaeriidae, Gastropoda, Crustacea, Insecta, Hydrachnida, Schizomycetes, and Angiospermae.

Observations of the habitat while using SCUBA revealed extensive distribution of Beggiatoa alba, the white sulfur bacterium, on the surface of the sediments in several areas of the lake. The physico-chemical and biological characteristics of two of the aquatic self-purification zones, polysaprobic and alpha mesosaprobic, are similar to those of the habitat of D. stagnalis in Douglas Lake; it is suggested that with some modification, these terms could be applied to the benthic portions of this lake.

The nematode must have a minimum of two points of contact to effect a gliding locomotion, otherwise it thrashes back and forth. The individuals form a tight, flat coil when removed from mud balls, or occasionally from particulate sediments. This species is probably carnivorous, feeding in part on oligochaetes or chironomids, or both; they may also be bacteriophagus, feeding on Beggiatoa. Bottom-feeding fish are the only reported predators of the nematode. Laboratory cultured individuals were found with hydra nematocysts in their cuticles, but hydra were never observed to ingest the worms. Only one case of a suspected parasite of the nematode was found in the Douglas Lake specimens, this was a gregarine-like cell in the intestine.

Microfilm $2.15; Xerox $7.60. 162 pages.

FACTORS INFLUENCING THE COURSE OF INFECTION OF LEISHMANIA DONOVANI IN THE WHITE MOUSE.

(L. C. Card No. Mic 59-3576)

Elizabeth M. Franchino, Ph.D.
Rutgers University, 1959

Major Professor: Dr. Leslie A. Stauber

The white mouse was shown to be susceptible to the Khartoum strain of Leishmania donovani. After intravenous inoculation of parasites there is typically an increase in parasite numbers to a peak followed by a number crisis to

a moderately low level of parasites, but the mouse maintains a chronic patent infection for at least three to six months.

The infection in the white mouse proved to be valuable for screening compounds against visceral leishmaniasis. The following compounds were tested and were found effective in altering the infection in mice: Fungizone, Xerosin, and Pentostam. Nystatin was slightly effective at the highest dosage tested.

It was shown that when cortisone was administered before or immediately after infection it was beneficial and reduced the amount of expected increase in parasite numbers. If cortisone was administered later in the infection, it proved to be deleterious and caused an increase in the amount of parasitization.

The mouse was shown to be resistant to superinfection with L. donovani after having been previously infected intraperitoneally with the parasite.

Two strains of mice, CF_1 and Swiss Webster, showed differences in reaction and course of infection after large inoculation of parasites. There were no differences in the course of infection produced in mice inoculated with parasites from different species of donor animals (cotton rat or hamster). Microfilm $2.00; Xerox $4.20. 77 pages.

A STUDY OF NATURAL AND INDUCED SUPERSEDURE OF THE QUEEN HONEY BEE, (APIS MELLIFERA L.).

(L. C. Card No. Mic 59-5305)

Norman Erwin Gary, Ph.D.
Cornell University, 1959

Experiments were conducted during the summers of 1957 and 1958 to assess the possibility of inducing supersedure in honey bee colonies containing queens and to study the natural supersedure process. The basic techniques used were the introductions of capped queen cells, aged virgin queens, and freshly grafted queen cells to colonies containing laying queens. Detailed data on colony conditions are recorded both before and after introductions were made. Italian queen cells were used during 1957 while cordovan cells were used during most of the experiments in 1958 to facilitate queen identification.

A colony entrance trap was developed to efficiently collect dead queen bodies as they were cast out. The dead bee trap was tested sufficiently to indicate its utility wherever dead, diseased, or poisoned bees are to be collected from within the colony. A portable colony weighing apparatus is also described.

Queen cells were introduced to 110 colonies in 1957 and 124 colonies in 1958 in small groups at intervals throughout the summer months. In a total of 234 colonies tested, fifteen colonies (6.4%) underwent induced supersedure accompanied by a short interruption in brood-rearing activities since the established queens were killed shortly after cell emergence. There was one exception where the old queen and the young introduced queen existed together for at least several weeks. In seventeen (7.3%) colonies both queens were killed shortly following cell emergence, leaving the colony to rear a queen from existing brood.

A small number (ten) of virgin queens five days old were introduced to brood chambers in Benton queen cages and they were immediately cast out of the colonies.

The introduction of freshly grafted cells containing one day old larvae to the brood chambers of ten colonies containing normal queens resulted in the provisioning and capping of forty per cent of the cells.

No swarming was caused by the introductions of capped queen cells to the queenright colonies.

The absence of correlation of the measurable colony conditions, for example, brood quantity, queen age, brood pattern, honey flow intensity, etc., to the observed supersedural phenomena lends credence to the operation of presently non-measurable variables such as queen pheromone availability within the colony.

Microfilm $2.05; Xerox $7.40. 156 pages.

A STUDY OF THE MYOLOGY OF THE LEAST SHREW, CRYPTOTIS PARVA (SAY).

(L. C. Card No. Mic 59-4375)

Carl Wesley Gugler, Ph.D.
The University of Nebraska, 1959

Advisers: Irving H. Blake and Robert M. Wotton

This study consists of an illustrated description of the myology of the least shrew, Cryptotis parva (Say), with comparative notes which are based on published descriptions of the myology of related insectivores. The study is incomplete; the superficial cervicoauricular musculature, the sacrospinalis group, part of the suboccipital group, the caudal flexor group, the lateral cervical group, parts of the lateral thoracolumbar group, and the perineal group are not included.

The accounts of the cranial and appendicular musculature are based on serial sections of these parts as well as on dissections.

The cranial and cervical musculature of Cryptotis differs from that of other described soricids in minor details. For example, the M. zygomaticus major is exposed throughout the length of its belly in Cryptotis, while it is partially or completely concealed in other soricids. The M. mylohyoideus does not insert directly on the basihyal, but into a broad sheet of loose fibrous tissue anterior to the basihyal; in other soricids this muscle is reported to insert on the basihyal. The sternohyoideus muscles in Cryptotis do not completely conceal the trachea as they are reported to do in other soricids.

Although the ocular muscles of Cryptotis are minute, they present the typical mammalian pattern of insertion. They arise from a fibrous capsule which encloses the eyeball and the greatly hypertrophied Harderian gland.

The appendicular musculature of Cryptotis differs from that of other soricids in more ways than does the axial musculature. Some of these differences may reflect variation in precision of techniques.

The distribution of tendons from the forearm muscles and the arrangement of the intrinsic muscles of the hand in Cryptotis show a mixture of generalized and specialized

characteristics. The tendons of the M. flexor digitorum sublimis split at the level of the proximal annular ligament, and pass around the tendon of the M. flexor digitorum profundus. This is presumably a more primitive arrangement than is the passing of the sublimis tendon to one side or the other of the profundus tendon without splitting. The Mm. flexores breves of the manus show a condition intermediate between the primitive arrangement, in which each pair arises separately from the associated metacarpal, and the specialized arrangement, in which all the flexores breves arise from a common tendon. The Mm. contrahentes, lumbricales, flexor digitorum manus, and palmaris brevis are absent in Cryptotis; this is characteristic of more specialized insectivores.

The distribution of tendons from the shank muscles differs from that of other soricids in minor details.

Cryptotis has a clearly defined M. abductor digiti quinti, which has not been reported in any other soricid.

Cryptotis is provisionally considered a relatively generalized mammalian type which is not markedly different from other soricids for which at least a part of the myology is known. Microfilm $2.00; Xerox $5.20. 105 pages.

THE SENSORY BASIS FOR HOMING IN THE LONGEAR SUNFISH, LEPOMIS MEGALOTIS MEGALOTIS (RAFINESQUE).

(L. C. Card No. Mic 59-4008)

Gerald Eugene Gunning, Ph.D.
Indiana University, 1959

The ability of the longear sunfish to return to a home range from an unfamiliar area 200 to 350 feet away was studied in Richland Creek, Indiana. Home range is defined as the area over which an animal normally travels, and return to a home range is called homing.

It was assumed that homing has a sensory basis. Attention was focused on the olfactory and visual senses, since these senses are known to be involved in homing in other species of fishes. Experiments were conducted with four major categories of fish: (1) blinded fish, (2) fish with olfaction impaired, (3) fish with both vision and olfaction impaired, and (4) controls. An electrical shocker was used for the collection of all fish.

The homing abilities of the three categories of treated fish were compared with the homing ability of controls. Blinded individuals homed as quickly and accurately as controls. For example, a total of 114 longear sunfish with the lenses removed from their eyes were displaced. Forty-one of these were recaptured and 31 (76 percent) homed. Of 109 controls displaced in the same manner, 35 were recaptured. Twenty-seven of the 35 (77 percent) homed. There is no significant difference between the homing abilities of the control and lens removal groups.

Fish whose olfactory mechanism was impaired moved at random. They could not return to the home range with the precision shown by controls. A total of 136 longear sunfish with their olfactory epithelium cauterized was displaced. Thirty-one were recaptured; 17 (55 percent) returned to their home ranges while 14 (45 percent) remained in the area to which they were displaced. Of 112 controls, 32 were recaptured. Twenty-nine of the 32 (91 percent) homed. A test of independence of the homing abilities of these two groups indicates a significant difference (chi-square = 8.38 with 1 d.f., $p = <.005$).

Those individuals with both senses impaired were entirely disoriented. Only one fish out of the 40 displaced was recaptured. This specimen was taken a considerable distance downstream from the release point.

Indirect evidence was derived from a study of the relative homing abilities of control longear sunfish moving upstream toward home versus those moving downstream toward home. The precision of those fish homing in the upstream direction was found to be greater than that of those moving downstream. This is to be expected since odors from the home range would be carried to fish homing in the upstream direction by the current.

The main conclusion was that the olfactory mechanism of the longear sunfish mediates homing. The fish search for their home range and apparently recognize the area by a characteristic odor, or possibly a combination of odors.
Microfilm $2.00; Xerox $4.20. 76 pages.

CENTRAL INTEGRATION OF DEVELOPING OPTIC NERVE FIBERS FROM SUPERNUMERARY OR ABNORMALLY POSITIONED EYES OF AMPHIBIANS.

(L. C. Card No. Mic 59-4926)

Emerson Hibbard, Ph.D.
University of Michigan, 1959

The purpose of this study was to determine whether neurons of grafted supernumerary eyes or eyes in abnormal positions could establish functional synaptic connections with brain centers of the host during neurogenesis. The establishment of such connections would indicate selective growth of nerve fibers toward particular terminal areas, efficiency in reaching these areas without being deflected from their course by the structural orientation of the host's brain, and an ability to compete with the normal nerve fibers in establishing functional connections with central neurons. Morphological and behavioral evidence of integration of anomalous tracts is also considered.

Five types of operations were performed. These included median eye implantations, contralateral transplantations of eyes, eye inversions, insertion of bone to block the decussation of nerve fibers in the optic chiasma, and telobiotic fusion of embryos. The first four of these were performed on Rana pipiens embryos at Shumway stage 17, while the last was performed on embryos at an early stage 16. Median eye implantations were also made on tailbud embryos of Amblystoma punctatum.

Twenty-six of the 180 median eye implantations in R. pipiens were serially sectioned at 10 microns and stained by Bodian's protargol method. Of these, 23 had formed extensive neural connections between the grafted brain parts and the brain of the host. Five specimens demonstrating functional sensory-motor relationships between the graft and host are described. These include two in which the grafted eye moved synchronously with the right eye of the host, two showing vestibular reflexes, and

one in which definite visuomotor responses of the host were mediated by the implanted eye. Evidence for the establishment of functional integration of nerve fibers in the latter specimen is discussed. This includes optokinetic response tests of visual perception by the implanted eye, photophobia, forced circling activity, and the differentiation of an extra Mauthner's cell in the medulla.

In cases in which the eyes were transposed to the contralateral side of the head, it was found that the optic nerve usually crossed to the opposite side of the brain and visual responses were normal. If, however, the optic nerve failed to decussate, abnormal drifting movements of the eyes resulted, apparently due to an incongruous representation of the visual field within the brain.

Optic nerve fibers from inverted eyes were prevented from leaving the eye in most cases, apparently due to failure of the proximal and distal stumps of the optic stalk to make contact following the operation. Blocked optic nerve fibers recurved to the inner plexiform layer of the retina, perhaps establishing synaptic connections with dendrites in this layer.

A series of eyes ranging from a single, normal appearing eye to eyes containing two complete sensory retinae and lenses were obtained from head-to-head fusions of embryos transected at the level of the eyes.

Decussation of optic nerve fibers was sometimes prevented by the insertion of bone fragments into the floor of the diencephalon before ingrowth of the nerves. When decussation was prohibited, the optic nerves recurved to the ipsilateral side of the brain, resulting in drifting movements of the eyes similar to those mentioned previously.

The results of these experiments indicate that central integration of anomalous optic tracts can be sufficiently precise to permit motor responses to sensory stimuli from implanted eyes. Morphological evidence also suggests that the orientation of the optic nerve fibers may be the result of (1) contact guidance, and (2) cellular affinities and functional relationships of the fibers and the centers where they terminate within the brain.

Microfilm $2.00; Xerox $5.40. 110 pages.

EVOLUTIONARY RELATIONSHIPS AMONG THE NORTH AMERICAN MALLARDS.

(L. C. Card No. Mic 59-5294)

Paul Austin Johnsgard, Ph.D.
Cornell University, 1959

A comparative morphological, behavioral, and electrophoretic study was undertaken on six populations of North American mallards, which are currently considered by the A.O.U. Check-list to comprise four species and two additional subspecies. These include Anas p. platyrhynchos, A. d. diazi, A. d. novimexicana, A. f. fulvigula, A. f. maculosa, and A. rubripes. These forms are essentially allopatric in their breeding distributions, with the exception of A. p. platyrhynchos and A. rubripes, which overlap over a several hundred mile zone in east central United States.

Geographic ranges and population sizes are estimated, and evidence for recent changes in the ranges of rubripes and platyrhynchos is presented, indicating that the present sympatry of these two forms is of recent origin and is rapidly increasing. Plumage differences in the populations were investigated by the "Hybrid Index" method and it was concluded that, except for the sexual dimorphism present in platyrhynchos, only minor quantitative differences in feather patterns differentiate the populations. Evidence from experimental hybridization was presented to show that the genetic basis of the sexual dimorphism of platyrhynchos is relatively simple, and should not be considered as an important taxonomic criterion. Quantitative analysis of the sexual behavior of the males of platyrhynchos and rubripes failed to show any important differences, other than slight differences in male response thresholds. Electrophoretic studies of the egg-white proteins of platyrhynchos, rubripes and fulvigula likewise failed to show any noticeable differences in the proportions and electrophoretic characteristics of these proteins.

A discussion of ecological, geographic and behavioral isolating mechanisms of the populations, and the incidence of hybridization where they overlap resulted in the conclusion that none of the forms could reasonably be considered to be specifically distinct from any or all of the others. It is recommended that diazi, fulvigula, and maculosa be considered geographic races of platyrhynchos, and that novimexicana be considered a synonym of diazi. It is also concluded that rubripes can not satisfactorily be considered a distinct species and that increasing hybridization indicates that it might better be considered a subspecies of platyrhynchos.

Microfilm $2.15; Xerox $7.60. 162 pages.

THE THORACIC MUSCULATURE OF THE INDIAN RAT FLEA, XENOPSYLLA CHEOPIS (ROTHSCHILD) 1903, ITS FUNCTION AND IMPLICATIONS IN THE PHYLOGENY OF THE ORDER SIPHONAPTERA.

(L. C. Card No. Mic 59-4527)

Robert Earl Lewis, Ph.D.
University of Illinois, 1959

The external and internal skeleton of the thoracic segments of Xenopsylla cheopis are described, with emphasis placed upon the high degree of functionality which has been gained by lateral compression and increased sclerotization. The thoracic musculature is discussed in detail with regard both for the points of attachment and the function of the various muscles. It is shown that many muscles which are usually found in pterygote insects have been lost by the Siphonaptera. Most of these muscles are those associated directly or indirectly with the powers of flight. It is further shown that these muscles have been replaced by enlargements of those muscles which function during the act of jumping.

The arrangement and distribution of the thoracic muscles indicates little relationship between the Siphonaptera and other orders of insects now known. The nearest relatives appear to belong to the order Mecoptera. This relationship, although extremely tenuous, is further substantiated by other biological and morphological characteristics possessed in common by both groups.

Since fleas are of recent geological origin, the lack of major affinities with other groups of insects is attributed

to a high degree of modification, imposed upon them by their habitat. The selective advantage of these acquired characteristics has resulted in a degree of homogeneity to be found in no other insect order.

Microfilm $2.00; Xerox $4.40. 85 pages.

THE SUBSPECIES OF CAMBARUS DIOGENES.

(L. C. Card No. Mic 59-4197)

Guy Marlow, Ph.D.
Tulane University, 1959

Chairman: George H. Penn

This dissertation is an analysis of Cambarus diogenes subspecies specimens contained in several museum collections in the United States. Emphasis is placed upon statistical analysis measurements and ratios obtained from measurements. A major section deals with origin of the Cambarus in the United States and subsequent spread over the continent. A theory is propounded for its origin and spread. Data are divided into major drainage categories for simplification of handling the data. C. d. ludovicianus is given a complete description and new facts are added to the description of C. d. diogenes and differentiation methods between the two.

Color patterns for the two are investigated. A statistical method for differentiation of the subspecies of Cambarus diogenes is found and used as a basic point for separation. Ontogenetic variation is considered in detail and points to prove its existence in this crawfish are brought out. Life history and ecology of the subspecies are considered in detail, being a summarization of past examinations and experiments.

Line graphs are employed to facilitate the data. Eight figures and three tables are included in this work.

Microfilm $2.00; Xerox $4.00. 75 pages.

INSULIN ACTION AND SUGAR TRANSFER.

(L. C. Card No. Mic 59-4168)

David Norman, Ph.D.
Purdue University, 1959

Major Professor: William A. Hiestand

The effect of insulin upon the permeability of D-galactose, D-xylose, L-xylose, mannitol, sucrose, and inulin has been examined in both the sectioned rat diaphragm and the intact diaphragm preparation of Kipnis and Cori. The former preparation consists of cut fibers where the cell membrane is not intact; the latter preparation contains relatively uninjured fibers where most of the fibers possess an intact cell membrane. In the intact preparation, sucrose, mannitol and inulin are excluded from the intracellular water but D-galactose, D-xylose, and L-xylose equilibrate in about 25 percent of the available cell water. Insulin increases the availability of cell water so that the latter sugars are distributed in about 70 per cent of the total cell water without increasing the diffusion rate per unit volume of available water. In the hemidiaphragm preparation, all of the sugars studied penetrate into the cut fibers relative to inulin, but the intracellular water of the tissue is not uniformly available for their permeation. Sucrose is distributed in a volume of only about 40-45 per cent of the available cell water, whereas all of the cell water appears to be available for sugars like D-xylose, D-galactose, L-xylose and mannitol, but the diffusion rate of these sugars varies. In hemidiaphragms, insulin increases the rate at which D-galactose and D-xylose equilibrate in the total cell water, but is without significant effect on the other sugars studied. The observation that the intracellular water of cut fibers is not uniformly available for sugars which have penetrated indicates that selectivity may not be an exclusive property of the cell membrane, but may occur at a cytoplasmic level as well. Insulin activity on sugar transfer was found to occur completely independent of either the transfer or the molar concentration, within isosmotic limits, of potassium, rubidium, or sodium. Definitive evidence for the preference of sugar transfer over glucose disappearance as a criterion for insulin activity is presented. The effect of insulin on the uptake of glucose is largely accounted for by its acceleration of sugar entry into the cell. Insulin was found to increase glycogen synthesis, but this increase is not explicable on the basis of an accelerated sugar transfer. In contrast to the notion that insulin acts on the cell membrane, these results suggest the possibility that insulin action involves alteration of a specific cytoplasmic region, thus facilitating permeation by certain sugars.

Microfilm $2.00; Xerox $4.00. 72 pages.

ON THE DEVELOPMENT OF THE KIDNEY OF MACROPODUS OPERCULARIS LINNAEUS.

(L. C. Card No. Mic 59-4462)

Norbert Kenneth Pietrzak, Ph.D.
University of Pittsburgh, 1959

This study was undertaken for the purpose of describing the development of the kidney of Macropodus opercularis, a representative of the family Anabantidae, from its first appearance through its full differentiation.

Sexually mature individuals were bred in order to secure developmental stages from gastrulation to adult. Eggs were removed at various intervals and fixed in Bouin's picro-formol acetic and imbedded in paraffin. Serial sections, both cross and longitudinal, were prepared and stained with eosin and hematoxylin. Reconstructions of the sections were made by using photomicrographs. The sections were plotted on graph paper.

The early pronephric kidney of Macropodus has its origin from intermediate mesoderm. The nephrotomal anlage is at first (32 hours after fertilization) a solid rod of cells wedged between the ectoderm and somatic mesoderm. Segmentation of the rod into so-called "nephrostomes" does not occur in the region of the pronephros and the pronephric tubule is never connected with the coelomic cavity.

A single pair of pronephric Malpighian units characterizes the pronephros of a stage 42 hours after fertilization.

A branch of the celiac supplies the pronephric capsules with glomeruli. The bilateral glomeruli fuse 23 days after hatching. Thus the late pronephros contains only a single median Malpighian body. This pronephric Malpighian body disintegrates when the mesonephros of either side develops at a stage 5 weeks after hatching. The pronephros disappears shortly after.

Masses of nephrogenous tissue concerned with the formation of mesonephric units originate from areas along the archinephric duct. In forming a mesonephric unit, the mass of tissue becomes crescentic, assumes a v-shape with distal and proximal portions indicated. The proximal end is concerned with forming the capsule; the distal end connects with the archinephric duct. The capillary knot is derived from a branch of the segmental artery. Bowman's capsule develops first followed by the formation of a lumen in the mesonephric tubule. Secondary mesonephric units are also found in Macropodus. The posterior cardinal sinuses, pseudolymphoid tissue, mesonephric tubules and glomeruli, nephrogenous tissue and branches of the posterior cardinal veins compose the completed mesonephric kidney.

The larva of a stage 5 weeks after hatching shows three distinct divisions of the cloaca; the urinary sinus is the most posterior part. The urinary bladder is formed by fusion of the archinephric ducts just before the urinary sinus.

At seven weeks after hatching the paired kidneys join caudally to form a single median mass.

The growing nephrogenous mass begins to envelop the pharyngeal pouches in Macropodus in a larva at a stage of 21 days after hatching. Complete envelopment of the pharyngeal pouches occurs at a stage 8 weeks after hatching.

The corpuscles of Stannius develop from the wall of the posterior section of the archinephric duct. These organs remain attached to the wall of the archinephric duct as long as the pronephros is present. Sections of the larva of a stage 6 weeks after hatching show these organs to be located in the extreme lateral portion of the mesonephros. The Stannian masses never acquire a lumen.

It appears, therefore, that the development of the kidney of Macropodus opercularis differs from those previously described in lacking nephrostomes, in having a transitory median Malpighian unit, and in its total absence in the adult. The mesonephros differs in that it has as many as 67 pairs of mesonephric tubules in the adult (this is a high number for such a small fish), the lumen of the mesonephric tubule forms only after the entire tubule is differentiated, and the fully formed kidneys largely enclose the labyrinthian organs.

The circulatory system in Macropodus does not differ notably from that found in other teleosts.

Microfilm $2.00; Xerox $4.40. 85 pages.

A STUDY OF THE MAMMALS OF THE DUNE ENVIRONMENT OF THE OREGON COAST WITH SPECIAL REFERENCE TO THE ADAPTIVE BEHAVIOR OF PEROMYSCUS MANICULATUS RUBIDUS.

(L. C. Card No. Mic 59-4320)

John Joseph Reardon, Ph.D.
University of Oregon, 1959

Adviser: R. R. Huestis

The problem of determining the nature of the mammalian population of the dunes of the central Oregon coast and of determining the adaptations of Peromyscus maniculatus rubidus, the deer mouse, to the dune environment was investigated at intervals during the years 1953-1956. Intensive field investigations were made during the summers of 1954 and 1955.

Field methods included: (1) a general survey of the principal geological and botanical aspects of the dunes; (2) a survey of the resident amphibians, reptiles and mammals; (3) live trapping of marked mammals on a gridded 7.46 acre segment of an isolated vegetated dune; (4) observation and tracking of Peromyscus and other mammals, and (5) determination of the location and nature of home sites of Peromyscus.

The barren sands of the dune region are arrayed in ridge systems which migrate under the influence of local winds. The entry of mammal life into the dune region is dependent upon the establishment of a suitable flora. A limited number of plant species including Juncus inventus, Fragaria chiloensis, Festuca rubra and Lupinus littoralis are capable of stabilizing sand, initiating the growth of stable dunes and providing a part of the vegetation complex needed to support a mammalian population. Development of older stabilized dunes bearing a cover of Pinus contorta, Vaccinium ovatum, Gaultheria shallon and Picea sitchensis provides a habitat capable of sustaining a restricted mammalian fauna. Six species of mammals including Peromyscus maniculatus and Sorex yaquinae comprise the resident mammalian population of the isolated fixed dunes.

The dune inhabiting mice of the genus Peromyscus occupied a home range of an average size of .5 acre. Maximum range size was .66 acre; a minimum size of .23 acres was recorded. The limits of the home ranges of mice occupying marginal areas on the isolated dune coincided with the limits of dense vegetation. Open areas were avoided. Observations and trap records indicate that barren areas present a relatively effective barrier. The extreme overlap of home ranges of mice of the same sex may be related to suppression of territoriality.

The dune mice are capable of climbing. Food sources, in the dense brushy habitat, are largely absent near ground level. Home sites of the dune Peromyscus occurred in relatively open locations in a habitat differing from the densely shaded situation in which the majority of routine travels were detected. The soils in which the burrows of the home sites occurred were warmer and drier than those of the soils over the general home range. Diurnal temperature fluctuations were within a narrow range in the soil surrounding the burrows. The home site preference serves to assure the resting animal of minimum heat losses.

The survival of Peromyscus in the dune habitat is in part related to the adaptive nature of its behavior.

Behavioral adaptations which have apparent survival value in the dune habitat include: (1) arboreal activity, (2) tolerance of overlap of home ranges and suppression of territoriality, (3) utilization of home sites in localities peripheral to the home range and (4) a choice of nesting site with minimal temperature range.

Microfilm $2.25; Xerox $7.80. 169 pages.

ROLE OF RATS AND MICE IN THE TRANSMISSION OF THE PORKWORM, TRICHINELLA SPIRALIS (OWEN, 1835) RAILLET, 1895.

(L. C. Card No. Mic 59-4864)

Harry Arthur Robinson, Ph.D.
Colorado State University, 1959

Rats and mice which have eaten one or more meals of trichinous meat may pass active viable trichinae in the feces which may serve as a source of infection of Trichinella spiralis (Owen, 1835) Raillet, 1895.

Flesh from wild rats, containing 1,500 cysts and 300 cysts per meal, was fed to experimental white rats and mice, respectively. One meal of trichinous meat and approximately 30 days later a second trichinous meal was fed to each trichina-free animal. Biopsy was used on experimental animals to determine the presence or absence of Trichinella. Feces were collected for 96 hours following a trichinous meal and examined for presence of cysts, larvae and adult trichinae. Infectivity of feces from animals that had eaten trichinous meat was tested by feeding them to trichina-free animals. Living trichina larvae free and in cysts were recovered from feces after being exposed to moist and drying conditions for varying periods to determine longevity of trichinae in an external environment.

Larvae and cysts recovered from the feces of 20 rats for 96 hours following the first trichinous meal ranged from 0 to 5.6 per cent of the total cysts fed with an average of 2.5 per cent per animal. From the second meal the range was 5.6 to 92.2 per cent with an average of 22.3.

Larvae and cysts recovered from the feces of 20 mice for 96 hours following the first trichinous meal ranged from 2.0 to 11 per cent of the total cysts fed with an average of 6.5 per cent per animal. From the second meal the range was 8.0 to 25.0 per cent with an average of 12.6.

Forty of 240 rats and mice were infected from feces resulting from the first and second meal of trichinous meat. Seven of 7 pigs were infected from infected feces of rats and mice which had eaten the first and second trichinous meal.

Two of 25 rats and mice were infected from dried feces resulting from the first 24-hour period after the first trichinous meal and none of 25 from feces of the second 24-hour period.

Four of 25 rats and mice were infected from dried feces resulting from the first 24-hour period after the second trichinous meal and one of 25 from feces of the second 24-hour period.

Six of 35 rats and mice were infected from moist feces resulting from the first 24-hour period after the first trichinous meal and none of 35 from the second 24-hour period.

The infective stages of Trichinella in feces were found to be cysts in undigested meat and sheathed larvae.

Larvae in cysts remained active up to eight days when exposed to drying conditions and 27 days under moist conditions. Free larvae did not live beyond two hours when exposed to dry conditions and four hours under moist conditions.

Moist conditions appear to be an important factor in maintaining active larvae in an external environment. Feces from animals which have eaten a meal of trichinous meat should be considered a short-term source of infection of T. spiralis. The danger of transmission of Trichinella by feces increases when the animal has been previously exposed to trichinae.

Microfilm $2.00; Xerox $5.40. 108 pages.

A REVISION OF THE AMERICAN GROUPERS (EPINEPHELUS AND ALLIED GENERA).

(L. C. Card No. Mic 59-4988)

Clarence Lavett Smith, Jr., Ph.D.
University of Michigan, 1959

The first section of this paper is devoted to a discussion of the habits and habitats of those sea basses known as groupers that are found in American waters. This is based on field investigations conducted in Bermuda, Bimini, and the Gulf of Mexico. Field and histological evidence indicates that most of these species are proterogynous, spending one or more seasons as functional females before maturing as males. An account is given of the osteology of the red hind, Epinephelus guttatus (Linnaeus), with particular reference to those features that are important as taxonomic characters in the groupers.

The systematic section is based upon examination of specimens in the major museums of the eastern United States and upon specimens collected or handled in the field by the author. Especial emphasis is placed on color pattern since these closely related fishes show relatively minor morphological modification. The numerous proportional measurements prove of limited value. Thirty-three species are recognized; they are distributed in seven genera as follows: Paranthias (1), Epinephelus (13), Dermatolepis (2), Cephalopholis (2), Petrometopon (2), Alphestes (2), and Mycteroperca (11). Keys for identification as well as synonymies, diagnoses, and descriptions are included for each genus and species and range maps are appended.

Taxonomic changes of especial interest include the suppression of the nominal genera Promicrops and Garrupa, and the synonymizing of Epinephelus niphobles with Epinephelus niveatus and of Alphestes galapagensis and Alphestes fasciatus with Alphestes afer, thus extending the known ranges of two species into the Eastern Pacific. Only a single species of Paranthias is recognized. Menephorus dubius seems to be a hybrid between Cephalopholis fulva and Paranthias furcifer.

Ten species are confined to the Eastern Pacific; sixteen are restricted to the Western Atlantic; four are found in both the Atlantic and the Pacific; and three occur in the Western and the Eastern Atlantic. In the Western Atlantic there seem to be two centers of endemism and probable

differentiations: the Gulf of Mexico, and the West Indies. The Gulf Stream acts as a barrier between these two regions. Most Pacific forms are closely related to, and presumably siblings of, some of the Western Atlantic species. Not all of these species pairs are equally differentiated and three or possibly four levels can be distinguished. These differences could be due to different evolutionary rates but may also be the result of different periods of isolation.

The same three levels of differentiation are discernable in the Western Atlantic between species of the Floridian subregion and those of the West Indian subregion. This is explained on the basis that during the times that there was an effective water passage across the Middle American Isthmus during the Cenozoic, there was a lessening of the barrier effect of the Gulf Stream, permitting interchange also between these areas. The mechanism of the periodic crossing of both barriers remains to be explained.

A phylogeny of the American groupers is hypothesized.

Microfilm $7.35; Xerox $25.20. 577 pages.

ADAPTATIONS FOR UNDERWATER SWIMMING IN THE COMMON MURRE, (URIA AALGE).

(L. C. Card No. Mic 59-4995)

Peter Rich Stettenheim, Ph.D.
University of Michigan, 1959

The Alcidae are among the few families of diving birds which use their wings for propulsion under water. The aims of this study were to describe the underwater swimming of alcids, to point out features of the pectoral girdle and wing which are adaptations for this habit, and to consider the significance of the habit as a factor in the evolution of the family.

Locomotion was observed both in captive birds and those in nature. Alcids dive and then swim under water in order to escape, to feed, or to engage in social activities. Individuals of certain species can reach depths of more than 240 feet and can remain submerged for at least two minutes, but most dives are less than half this depth or duration. When an alcid dives, it probably reduces its buoyancy by releasing some of the air beneath the feathers. The half-spread wings furnish most of the propulsion under water as they swing downward, backward, and mediad. Other wing actions are used to keep the bird at a desired depth, to brake, or to turn. The feet are employed relatively little except when the bird turns.

The distance from the anterior border of the last cervical vertebra to the posterior border of the fifth thoracic vertebra was used as a measure of body size. Alcids weigh approximately the same as other charadriiform birds of equal body size but their wings are relatively much smaller. This modification facilitates movement of the wings under water but results in rapid-flapping, poorly controlled flight in air.

Adaptive features of the trunk, pectoral girdle, and wing skeleton are demonstrated through comparison of the Common Murre with other charadriiform birds and other diving birds. These features include additional thoracic vertebrae, enlarged hypapophyses, long sternum and keel, strongly bowed furcula, short wing segments, broadened humerus, radius, and ulna, and enlarged articular head of the humerus.

The ligaments of the pectoral girdle and wing in the murre are described and their functions are discussed. Several of the wing ligaments are better developed in the murre than in the marbled godwit (Limosa fedoa) or the laughing gull (Larus atricilla). These modifications are viewed as adaptations for use of the wings under water because they reinforce the joints.

The arrangement of the fleshy and the tendinous fibers as well as the gross morphology is described for each of the muscles of the pectoral girdle and the wing in the murre. The action of each muscle is postulated from an analysis of its placement and internal structure. Comparisons are made with the muscles of the godwit and the gull. Modifications of certain muscles enable the murre to adduct and depress its humeri more powerfully than the other species. Numerous other muscles show adaptations which streamline the wing or affect its action.

Alcids may have evolved from undifferentiated charadriiform birds which lived along shores. There is anatomical evidence that they are as distantly related to the Lari as to the Charadrii. The abilities for diving and underwater swimming have been important factors in the history of the family. Many of the morphological features which characterize alcids are also adaptations for these locomotor habits. Some of the adaptations have had consequences in the nature of aerial flight, which in turn have imposed restrictions on nesting sites. The birds have been able to utilize pelagic fish and invertebrates as a food supply. The use of the wings for propulsion under water has been a basis for extreme specialization in certain alcids and their close relatives.

Microfilm $3.95; Xerox $13.40. 307 pages.

EMERGENCE OF THE LARCH SAWFLY, PRISTIPHORA ERICHSONII (HARTIG) IN RELATION TO SOIL TEMPERATURE AND WEATHER PATTERNS.

(L. C. Card No. Mic 59-3768)

William James Turnock, Ph.D.
University of Minnesota, 1959

This thesis investigates the factors influencing the duration of the post-diapause stage of the larch sawfly. Laboratory studies showed that the duration of this stage may be altered by varying the temperature immediately after cocoon formation, during cold exposure, and during the post-diapause period. Optimum temperature conditions include at least 14 days at 10^{0} C before cold exposure, about 200 days at 0^{0} to 5^{0} C and incubation at 15^{0} C. Even at these constant temperatures, the length of the post-diapause period varied considerably.

In bog forests near Prince Albert, Saskatchewan, soil temperatures were extremely variable during the period from disappearance of winter snow to the end of the emergence period. Differences in soil temperature were associated with forest cover, water table, microtopographic variation and depth beneath the surface as well as meteorological phenomena. Attempts to predict adult emergence

patterns gave variable results and required several assumptions and considerable labour.

The use of large scale meteorological data showed that the number of days from the disappearance of winter snow to the first adult emergence at Prince Albert was increased by anticyclonic activity and decreased by northward-moving cyclones originating in the Colorado - Wyoming region. Light rains favoured emergence by warming the deeper layers of soil but heavy rains raised the bog water levels and retarded sawfly development and increased mortality by submerging the cocoons. Short-term weather forecasts could be used to predict whether development will be hastened or retarded. The results could also be used to predict the general emergence patterns from long range forecasts of circulation patterns when these become available.

Microfilm $2.00; Xerox $6.40. 133 pages.

HYBRIDIZATION IN NORTH AMERICAN GROSBEAKS, GENUS PHEUCTICUS.

(L. C. Card No. Mic 59-5295)

David Armstrong West, Ph.D.
Cornell University, 1959

Two North American grosbeaks, Pheucticus ludovicianus and melanocephalus, inhabit woodland east and west of the Great Plains respectively. Their ranges meet in the riparian forests along the Plains rivers, and there they interbreed. It is suggested that the two forms evolved in isolation after the retreat of the Pleistocene ice sheet and that the grasslands of central North America prevented genetic contact between them. The recent rejunction of their ranges is a secondary contact. The zone of hybridization is approximately 200 miles across at its widest point, along the Platte River in Nebraska. The aim of the present study is the description of the extent and nature of hybridization between these morphologically distinct populations of birds.

A collection of 308 adult specimens, representing both forms and hybrids between them, was made (1955, 1956, 1957) in Nebraska, South Dakota and Colorado.

The grosbeaks act as geographically replacing forms. Habitat preference, nest, eggs and vocalizations are very similar.

Although the males differ in certain plumage colors, there is great similarity in plumage pattern. Some features of adult male melanocephalus are represented in many adult ludovicianus in a less well developed form.

The plumage of females is very similar.

There is an overlap in all mensural characters investigated.

The variation found in hybrids suggests that backcrossing and the production of second generation hybrids is occurring. The characters of the hybrids are analyzed by means of a Hybrid Index scheme. At most localities within the zone of hybridization phenotypically pure individuals of both forms, as well as hybrids, were found. The apparent lack of complete breakdown may be due to assortative mating, but the data are inconclusive.

There is some evidence of expansion of the zone of hybridization within this century. It is probable that man has contributed to this increase through river stabilization and tree-planting.

The two grosbeaks are in reproductive contact where their ranges overlap. Available evidence suggests that hybrids are not at a disadvantage and that the two forms are members of a polytypic species. Taxonomically they should be treated as subspecies and thus become: Pheucticus ludovicianus ludovicianus (Linnaeus) and P. l. melanocephalus (Swainson).

Microfilm $2.00; Xerox $4.80. 95 pages.

CARBON DIOXIDE SENSITIVITY IN DROSOPHILA AFFINIS AND DROSOPHILA ATHABASCA.

(L. C. Card No. Mic 59-4382)

David Lee Williamson, Ph.D.
The University of Nebraska, 1959

Adviser: Dwight D. Miller

A search for CO_2 sensitivity has resulted in the discovery of the phenomenon in several native American species. CO_2 sensitivity was found in laboratory strains of D. tolteca from Central America and later in wild-caught D. athabasca from Canada and Alaska and D. affinis from Nebraska and Missouri, as well as in certain laboratory strains of D. affinis (Nebraska, Iowa) and D. athabasca (Alaska, Quebec).

In addition to D. affinis, D. athabasca, and D. tolteca, CO_2 sensitivity was found to exist in wild-caught D. algonquin, D. melanogaster, D. pseudo-obscura, and D. robusta. However, only pure sensitive strains of D. affinis and D. athabasca have been established as laboratory stocks.

Following the establishment of pure sensitive strains of D. affinis and athabasca the nature of the inheritance of CO_2 sensitivity in these two species was studied. Matings between females from a sensitive strain of D. athabasca (Matanuska Valley, Alaska) and males from a resistant strain (of mixed Wyoming and Quebec origin) resulted in 99% sensitive offspring. A 100% sensitivity level was maintained through three backcrosses of sensitive females to males of the resistant strain. The results are consistent with an extrachromosomal basis for sensitivity in this species.

The reciprocal cross in D. athabasca resistant female mated to sensitive male, yielded offspring which were 37% sensitive. Males inheriting sensitivity from the male parent only transmitted this sensitivity to 21% of their offspring. In D. melanogaster sensitivity is not transmitted by a male that inherited its sensitivity from its father alone (L'Héritier, 1948).

In D. affinis matings between females from a sensitive strain from Humboldt, Nebraska, and males from a resistant strain (Chadron State Park, Nebraska) yielded 100% sensitive offspring. A 100% sensitivity level has been maintained through five backcrosses of sensitive females to males of the resistant strain indicating an extrachromosomal basis for CO_2 sensitivity inheritance in this species.

The reciprocal cross in D. affinis, resistant females mated to sensitive males, gave progeny that were about 99% sensitive. Males inheriting their sensitivity from their fathers alone mated to resistant females yielded sensitive offspring with frequencies ranging from 3% to 21%. Again, this is contrary to breeding results expected from such a cross in D. melanogaster.

Resistant D. athabasca injected with an extract prepared from sensitive flies of the same species acquired sensitivity as early as seventeen days after injection. The injected sensitive flies transmitted this sensitivity to some of their offspring.

Flies from resistant strains of D. affinis injected with an extract prepared from sensitive flies of this species also developed sensitivity. Sensitivity appeared in this species between twenty-one and twenty-six days after injection. Sensitivity was transmitted to the offspring of injected flies and a neostabilized strain of D. affinis has been established.

Adult flies from 100% sensitive strains of D. affinis and D. athabasca kept at 30°C. for seven days became, respectively, 32% and 71% resistant to CO_2. The resistant flies from both species were then kept at 20° C. for twenty days. The surviving resistant D. affinis were all sensitive again at the end of twenty days, while the surviving D. athabasca were nearly all resistant.

Resistant D. pseudoobscura injected with an extract prepared from sensitive D. melanogaster from Plattsmouth, Nebraska, developed sensitivity symptoms.

Microfilm $2.00; Xerox $4.00. 71 pages.

NEUROCHEMICAL ALTERATIONS IN THE BRAIN OF THE NEWBORN AFTER ASPHYXIA NEONATORUM.

(L. C. Card No. Mic 59-4190)

Thomas Oliver Wilson, Ph. D.
Purdue University, 1959

Major Professor: William A. Hiestand

Since cell function is intimately related to enzyme activity, then the possibility exists of being able to demonstrate fundamental differences between damaged and normal tissues by assaying and comparing enzyme activities from such tissue. Asphyxia neonatorum is known to impair the normal functioning of cerebral tissue. Some of the damage resulting from neonatal asphyxiation was assumed to be the result of altered enzyme activity caused by an accumulation of metabolites arising during the period of asphyxiation. Three enzymes associated with mitochondria were chosen because of the relationship of mitochondria to the maintenance of cellular integrity.

Fetal guinea pigs one day prior to parturition were delivered by Cesarean section. One animal was delivered immediately and one of the remaining fetuses was asphyxiated in utero by clamping off the umbilical cord. The animals were asphyxiated from 3 to 10 minutes. At the termination of asphyxiation they were delivered and resuscitated. Two days later, the control and asphyxiated animals were decapitated; immediately afterwards the tissue samples were removed, frozen in liquid nitrogen, sectioned 20 μ thick and dried under high vacuum at -70°C. The frozen-dried tissue sections were assayed by using ultra-micro-spectrophotometric procedures for adenosinetriphosphatase, cytochrome oxidase and lactic dehydrogenase. Adenosinetriphosphatase activity was measured by producing the phosphomolybdenum blue color complex from the inorganic phosphate released from the ATP substrate. Cytochrome oxidase was measured by following the rate of oxidation of reduced cytochrome C during a two minute period. Lactic dehydrogenase activity was measured by the color produced with quinolylhydrazine and the pyruvate formed.

Adenosinethriphosphatase activity was found, generally, not to be altered in the asphyctic animals. One exception to this was the group of animals that had been asphyxiated for a period of 10 minutes. The reduced activity was found in the external granular layer. The mean activity fell from 1.363 M/Kg dry wt./hr of inorganic phosphate liberated for the control animals to 1.095 M/Kg/hr.

Cytochrome oxidase was found to be significantly reduced in activity for all asphyxial groups. There was a progressive diminution from 3 minutes to 9 minutes of asphyxiation. The reduction in activity began, however, to level off in animals asphyxiated for 8 minutes. The most pronounced changes occurred in the external granular layer. The activity fell from a mean of 6.75 M/Kg dry wt/hr of substrate oxidized for the control animals to a low of 1.92 M/Kg dry wt/hr. for animals asphyxiated 9 minutes. There also was a reduction in the enzymatic activity of the pyramidal layer.

Lactic dehydrogenase activity was not found to be significantly altered with increasing duration of asphyxiation.

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